Vol. 10, No. 5
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Energy Research Abstracts

Abstracts 8105-9429

Office of Scientific & Technical Information
UNITED STATES DEPARTMENT OF ENERGY

CURRENT AWARENESS PUBLICATIONS ON ENERGY

To provide complete coverage of literature related to major Department programs, announcement publications that are comprehensive in their coverage of certain energy fields are issued regularly. All information in these publications, plus additional backup information, is included in the Energy Data Base of the Office of Scientific and Technical Information; all references are also available for machine searching via the on-line retrieval system, DOE/RECON, and the commercial on-line retrieval systems. Descriptions of these current awareness publications, which are supported either directly or indirectly by the DOE, appear below. Department of Energy components may receive the listed publications free from the Office of Scientific and Technical Information, U. S. Department of Energy, P. O. Box 62, Oak Ridge, TN 37831. Telephone (615) 576-1301; FTS 626-1301.

PUBLICATIONS OF THE OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

Energy Abstracts for Policy Analysis (EAPA)

A monthly abstract journal devoted to the analysis of energy research, conservation, and policy. Scope and coverage are limited to substantive articles or reports and emphasize legislative, regulatory, and other legal aspects, as well as social, economic, and environmental impacts. *EAPA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The annual subscription price is $72.00 for domestic (North America) or $90.00 for foreign (outside North America) subscribers; a single issue is $5.00 or $6.25, respectively.

Energy Research Abstracts (ERA)

A comprehensive semimonthly abstract journal devoted to all areas of energy-related information produced by the Department of Energy, other U. S. government organizations, and foreign governments. *ERA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The annual subscription price for the 24 issues is $146.00 for domestic (North America) subscribers or $182.50 for foreign (outside North America) subscribers. A single issue is $14.00 or $17.50, respectively.

DOE Patents Available for Licensing (PAL)

DOE is prepared to grant exclusive or nonexclusive, revocable licenses under DOE-owned U. S. patents and patent applications; this semiannual publication provides abstracting and indexing coverage of this literature. *PAL* is available on subscription (use PB85-946800) from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. The annual subscription price is $14.00 for domestic (North America) or $28.00 for foreign (outside North America); a single issue is $7.00 or $14.00, respectively.

Energy Meetings (EM)

A monthly listing of conferences, symposia, workshops, etc., pertaining to DOE's programmatic interests. *EM* is available on subscription (use PB85-901500) from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. The annual subscription price is $40.00 for domestic subscribers and $80.00 for subscribers outside the North American continent; a single issue is $5.00 and $10.00, respectively.

The following monthly update journals are available to the public on subscription from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161; use the identifying order number (PB- No.) when subscribing. The annual subscription price (12 issues plus cumulative index) is $75.00 for domestic (North America) and $150.00 for foreign (outside North America) subscribers; a single issue is $7.00 and $14.00, respectively.

***Current Energy Patents (CEP)*–PB85-902800**

Devoted to international patent literature, including patent applications, on any aspect of energy production, conservation, and utilization.

***Energy and the Environment (EAE)*–PB85-914900**

Devoted to information on the impacts of energy-related activities and radioactive and nonradioactive pollutants on the environment.

***Fossil Energy Update (FEU)*–PB85-914600**

Devoted to information on the exploration, development, processing, and use of fossil fuels.

***Fusion Energy Update (CFU)*–PB85-915300**

Devoted to information on controlled thermonuclear fusion, including plasma and fuel research and power plant engineering and conceptual design studies.

***Solar Energy Update (SEU)*–PB85-914500**

Devoted to information on the utilization of solar energy, including biomass and tidal and wind power.

The following semimonthly bulletins are also available from the National Technical Information Service. The annual subscription rate for one volume (calendar) year (24 issues; no indexes) is $40.00 for domestic (North America) and $80.00 for foreign (outside North America) subscribers; use the identifying order number (PB- No.) when subscribing.

***Acid Precipitation (APC)*–PB85-901000**

Covers all aspects of acid precipitation, including effects and possible control measures.

***Buildings Energy Conservation (BEC)*–PB85-900700**

Covers worldwide information on the technology required for energy conservation in buildings of all types.

***Coal-Based Synfuels (CBS)*–PB85-901400**

Covers all aspects of conversion of coal into gaseous or liquid fuels.

***Coal Preparation and Pollution Control (CPC)*–PB85-901800**

Covers all aspects of coal preparation and cleaning and reducing pollution from its direct combustion.

***Direct Energy Conversion (DEC)*–PB85-946600**

Covers the following areas: photovoltaics, magnetohydrodynamics, electrohydrodynamics, thermoelectrics, thermionics, and fuel cells.

***Energy from Biomass (EFB)*–PB85-900600**

Covers worldwide information on all aspects of biomass production, conversion, and utilization for energy.

***Geothermal Energy Technology (GET)*–PB85-914700**

Covers information on the exploration, development, and utilization of geothermal resources.

***Heavy-Ion Reactions (HIR)*–(PB85-900500)**

Covers all aspects of heavy-ion (A > 4) reactions.

***Laser Research (LAR)*–PB85-901100**

Covers all aspects of laser research and development, but excludes applications.

***Nuclear Fuel Cycle (NFC)*–PB85-913400**

Covers all aspects of the nuclear fuel cycle, both front end and back end.

***Nuclear Reactor Safety (NRS)*–PB85-913500**

Covers the safety aspects of accident analysis, safety systems, radiation protection, decommissioning and dismantling, and security measures.

***Radioactive Waste Management (RWM)*–PB85-902900**

Covers the management aspects of transport and storage, waste processing, waste disposal, waste storage, radioactive effluents, and shipping containers.

***Solar Thermal Energy Technology (STT)*–PB85-901200**

Covers research in materials, concentrators/receivers, salinity gradients, etc., for development of efficient and reliable solar thermal conversion systems.

***Unconventional Petroleum (UCP)*–PB85-901300**

Covers all aspects of secondary and tertiary recovery of petroleum and of oil shales and tar sands.

INTERNATIONAL ENERGY PUBLICATIONS

The Office of Scientific and Technical Information (OSTI) cooperates in the publication of international abstract journals with the following: (1) International Atomic Energy Agency, International Nuclear Information System, Vienna, Austria, for *Atomindex;* (2) International Energy Agency, Biomass Conversion Technical Information Service, Dublin, Ireland, for *Biomass Abstracts;* and (3) International Energy Agency, IEA Coal Research, London, England, for *Coal Abstracts.* In each case, the cognizant foreign agency provides the non-U. S. information to OSTI for inclusion in the Energy Data Base; in turn, OSTI provides the U. S. information for input into the respective journal.

Atomindex

A semimonthly abstract journal providing worldwide coverage of information on nuclear science and technology. *Atomindex* is available by subscription from UNIPUB, 345 Park Avenue South, New York, NY 10010. The cost of an annual subscription, 24 semimonthly issues and semiannual and annual cumulative indexes, is $290.

Biomass Abstracts

A bimonthly abstract journal with comprehensive coverage of information in any step involved in the eventual conversion of biomass to energy. *Biomass Abstracts* is available free to Department of Energy components and contractors from OSTI. Non-DOE organizations may obtain *Biomass Abstracts* from Biomass Conversion Technical Information Service, Institute for Industrial Research and Standards, Ballymun Road, Dublin 9, Ireland, for 42 IR pounds per year. Make checks payable to the Institute.

Coal Abstracts

A monthly abstract journal providing comprehensive worldwide coverage of information in the field of coal science and technology. *Coal Abstracts* is available to Department of Energy components and contractors from OSTI. Non-DOE organizations may obtain *Coal Abstracts* from IEA Coal Research, Technical Information Service, 14-15 Lower Grosvenor Place, London SW1W 0EX, England, for 100 pounds sterling per year.

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ENERGY RESEARCH ABSTRACTS

ABOUT THE OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

The Office of Scientific and Technical Information (OSTI) in Oak Ridge, Tennessee, has been the national center for scientific and technical information for the Department of Energy (DOE) and its predecessor agencies since 1946. In developing and managing DOE's technical information program, OSTI places under bibliographic control not only DOE-originated information but also worldwide literature on scientific and technical advances in the energy field and announces the source and availability of this information. Whereas the literature of science is emphasized, coverage is extended to DOE programmatic, socioeconomic, environmental, legislative/regulatory, energy analysis, and policy-related areas. To accomplish this mission, OSTI builds and maintains computerized energy-information data bases and disseminates this information via computerized retrieval systems and announcement publications such as abstracting journals, bibliographies, and update journals. Direct access to OSTI's most comprehensive data base, the Energy Data Base, is available to the public through commercial on-line bibliographic retrieval systems. The Energy Data Base and many of OSTI's energy-related data bases are available to DOE offices and contractors and to other government agencies via DOE/RECON, the Department's on-line information retrieval system. The Office of Scientific and Technical Information has developed and maintains systems to record and communicate energy-related research-in-progress information, to maintain a register of DOE public communications publications, to track research report deliverables from DOE contractors, and to test and make available DOE-funded computer software programs with scientific and management applications; OSTI also serves as adviser for special publication needs of the Department. To effectively manage DOE's technical information resources, OSTI's program is one of continual development and evaluation of new information products, systems, and technologies.

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ABOUT *ENERGY RESEARCH ABSTRACTS*

Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

ERA is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Inquiries should be directed to the Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

ERA is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues is $146.00 for domestic subscribers and $182.50 for foreign subscribers. A single issue costs $14.00 (domestic) or $17.50 (foreign). The cumulative indexes will be available in printed form from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402, and in microfiche form from the National Technical Information Service, U. S. Department of Commerce, Springfield, VA 22161, and from Engineered Systems, P. O. Box 866, Oak Ridge, TN 37831.

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United States Department of Energy, P. O. Box 62, Oak Ridge, TN 37831

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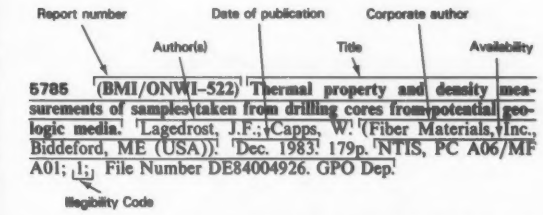
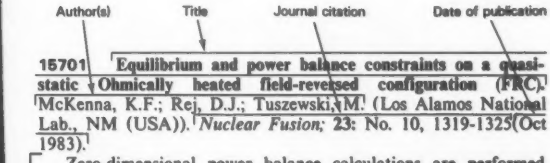
ABSTRACTS IN *ENERGY RESEARCH ABSTRACTS*

The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.


Report number
Date of publication
Corporate author
Author(s)
Title
Availability
5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. (Fiber Materials, Inc., Biddeford, ME (USA)). Dec. 1983. 179p. NTIS, PC A06/MF A01; 1; File Number DE84004926. GPO Dep.
Legibility Code

Abstract

Density, steady-state conductivity, enthalpy, specific heat, heat capacity, thermal diffusivity and linear thermal expansion were measured on 59 materials from core drill samples of several geologic media, including rock salt, basalt, and other associated rocks from 7 potential sites for nuclear waste isolation. The measurements were conducted from or near to room temperature up to 500°C, or to lower temperatures if limited by specimen cracking or fracturing. Ample documentation establishes the reliability of the property measurement methods and the accuracy of the results.


Author(s)
Title
Journal citation
Date of publication
15701 Equilibrium and power balance constraints on a quasi-static, Ohmically heated field-reversed configuration (FRC). McKenna, K.F.; Rej, D.J.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). Nuclear Fusion; 23: No. 10, 1319-1325 (Oct 1983).

Abstract

Zero-dimensional power balance calculations are performed for a quasi-static, purely Ohmically heated field-reversed configuration. Without compression, the constraint imposed by radial pressure balance limits the power input. Estimates of the energy loss from impurity line radiation as well as from classical and anomalous transport are given. Effects of cold puff gas injection are also investigated.

INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA)*. Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

• Corporate Author Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

5785 (BMI/ONWI-522) **Thermal property and density measurements of samples taken from drilling cores from potential geologic media.** Lagedrost, J.F.; Capps, W. **(Fiber Materials, Inc., Biddeford, ME (USA)).** Dec. 1983. 179p. NTIS File Number DE84004926. GPO Dep.

is indexed as:

Fiber Materials, Inc., Biddeford, ME (USA)

• Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Capps, W., *See* Lagedrost, J. F.
Lagedrost, J.F., Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
McKenna, K.F., Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;US)
Rej, D.J., *See* McKenna, K.F.
Tuszewski, M., *See* McKenna, K.F.

• Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

SALT DEPOSITS
Density
Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
REVERSED-FIELD PINCH
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• Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

AC06-76RL01830 **Fiber Materials, Inc., Biddeford, ME (USA)** 9:5785 BMI/ONWI-522

• Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under a File Number, that number is included in the availability statement. A file number–report number correlation is included for convenience.

BMI/ONWI-522	**9:5785**	**NTIS, PC A09/MF A01. File Number DE84004926, Distribution Category MN-70**

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CEA Centre d'Etudes de Saclay
GIF-sur Yvette Cedex, France

Fachinformationszentrum
Energie, Physik, Mathematik GmbH
Karlsruhe, Federal Republic of Germany

IEA Biomass Conversion Service
Dublin, Ireland

IEA Coal Research
Technical Information Service
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New York, NY

University of Tennessee
Graduate School of Library and Information Sciences
Knoxville, TN

Communication concerning the editorial policy and content of *Energy Research Abstracts* should be addressed to the Editor, *Energy Research Abstracts,* Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

SUBJECT CONTENTS (NUMERICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 40 first-level and 293 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope definitions and limitations is available as DOE/TIC-4584-R5 from NTIS for $9.50.

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REFER ALSO TO CITATION(S) 0104008172, 8357, 8721, 9424, 9424, 9425, 9425

8105 (ANL/FE—84-14) Instrumentation and control for fossil energy. Quarterly technical progress report, January-March 1984. (Argonne National Lab., IL (USA)). Oct 1984. Contract W-31-109-ENG-38. 59p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85004828.

Progress during the quarter January-March 1984 in the Instrumentation and Control for Fossil Energy Program is reported. Work reported includes developments in several tasks related to coal gasification and liquefaction processes. Some of the tasks involve measurement of the solid component feedrate in solid/gas and solid/liquid feedlines and similar process streams. The measurements have been made using a newly developed electronics package to compute the solids mass flowrate, and velocity- and density-sensing hardware based on capacitive, acoustic, and gamma transmission techniques. Other tasks include development of instruments to measure temperature and level in coal gasification and liquefaction systems, advanced research and development technology evaluation of techniques from the geometrical- and physical-parameter points of view, and multiphase flow studies as related to instrument development and scale-up. The report also covers activities to operate, maintain, and modify the Solid/Gas Flow Test Facility and Slurry Loop Test Facility at Argonne National Laboratory. 13 references, 21 figures, 5 tables.

8106 (CONF-8404200—1) Fundamentals of coal gasification. Hedden, K.; Gudenau, H.W. (DECHEMA Deutsche Gesellschaft fuer Chemisches Apparatewesen e.V., Frankfurt am Main (Germany, F.R.)). 1984. 1p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number TI85770045.

From 308. DECHEMA colloquium: production of synthesis gas in molten iron; Frankfurt am Main, F.R. Germany (5 Apr 1984).

The various gasification agents are pointed out, the equations for reaction outlined and, among other items, the conversion of coal with steam discussed. This is followed by a description of reaction rates and a listing of the various parameters of importance. As an example, the influence of pressure and temperature on steam gasification and on hydrogasification is outlined. Of the various reactors possible, the packed bed, fluidized bed and entrained catalyst system are presented in more detail and the pig iron bath reactor and slag bath reactor are also briefly mentioned.

8107 (CONF-8404200—2) Coal gasification in molten iron using the Humboldt process. Hedden, K.; Pook, H. (DECHEMA Deutsche Gesellschaft fuer Chemisches Apparatewesen e.V., Frankfurt am Main (Germany, F.R.)). 1984. 1p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number TI85770046.

From 308. DECHEMA colloquium: production of synthesis gas in molten iron; Frankfurt am Main, F.R. Germany (5 Apr 1984).

KHD Humboldt Wedag AG and Sumimoto Metals, Japan, are currently developing a coal gasification process based on carrying out the process in a molten iron bath. The pig iron with C-content of approx. 3-4.5%, coal, lime, oxygen and other media are blown into the iron bath contained in a closed and brick-lined reactor via floor and wall jets. The carbon content of the pig iron is kept constant by adjusting the coal and oxygen input ratio. The reaction temperature lies between 1400 and 1450°C, whereby the high degree of solubility of caron in molten iron is an essential feature of this process. The gas produced is desulphurised to a high degree by appropriate slag conduction and sulphur levels in the gas of less than 20 ppm can be achieved. Depending on plant design the gasifier pressure lies between 3 and 10 bar. A dust collector with integrated heat recycling is coupled to the process.

8108 (DOE/ET/10205—1689) Fixed-bed gasification research using US coals. Volume 1. Program and facility description. Thimsen, D.; Maurer, R.E.; Poole, A.R.; Pui, D.; Liu, B.; Kittleson, D. (Black, Sivalls and Bryson, Inc., Houston, TX (USA)). 1 Oct 1984. Contract AI21-77ET10205. 125p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85002000.

The United States Department of Interior, Bureau of Mines, Twin Cities Research Center, Minneapolis, Minnesota is the site of a 6.5 foot diameter Wellman-Galusha gasifier, installed in 1977-1978. This gasifier, combustor/incinerator, and flue gas scrubber system in the past had been operated jointly by Bureau of Mines personnel, personnel from member companies of the Mining and Industrial Fuel Gas Group, and United States Department of Energy personnel-consultants. Numerous tests using a variety of coals have to date been performed. In May of 1982, Black, Sivalls and Bryson, Incorporated (BS and B) was awarded the contract to plan, execute, and report gasification test performance data from this small industrial fixed-bed gasification test facility. BS and B is responsible for program administration, test planning, test execution, and all documentation of program activities and test reports. The University of Minnesota, Particle Technology Laboratory (UMPTL) is subcontractor to BS and B to monitor process parameters, and provide analysis for material inputs and outputs. This report is the initial volume in a series of reports describing the fixed-bed gasification of US coals at the Bureau of Mines, Twin Cities Research Center. A history of the program is given in Section 1 and a thorough description of the facility in Section 2. The operation of the facility is described in Section 3. Monitoring systems and procedures are described in Sections 4 and 5. Data reduction tools are outlined in Section 6. There is no executive summary or conclusions as this volume serves only to describe the research program. Subsequent volumes will detail each gasification test and other pertinent results of the gasification program. 32 references, 23 figures, 15 tables.

8109 (DOE/ET/10518—T5) Catalytic coal liquefaction. Quarterly report, April-June 1980. Weller, S.W. (State Univ. of New York, Buffalo (USA)). 1980. Contract AC22-76ET10518. 13p. (FE—2013-13). NTIS, PC A02/MF A01; GPO Dep. File Number DE85004630.

Monolith catalysts of MoO_3-CoO-Al_2O_3 have been prepared and tested for coal liquefaction in a stirred autoclave. Pure γ-Al_2O_3 monolith (Corning) having 200 square channels/in^2 and an average pore diameter of 225 A was used as substrate. The monolith catalyst was tested both as whole pieces and as a crushed particulate. Each catalyst was prepared with two loadings of MoO_3 and CoO, and each was tested in the oxide or in the presulfided form. A blank run with the empty catalyst holder in place showed higher conversion of asphaltene to oil than a blank run without catalyst holder; this may be evidence for a mechano-chemical effect in oil production. An effect of stirring speed was also found with monolith catalyst: liquefaction and H_2 consumption were notably less at 400 rpm than at 950 rpm. Presulfiding had little effect on the effectiveness of monolith catalysts, but low loading of MoO_3 and CoO on the support gave better results than high loading, for equal weights of MoO_3 and CoO charged. Whole monolith pieces showed slightly lower liquefaction than their crushed counterparts. In general, the monolith catalysts were not as good as the particu-

late catalysts described in the previous quarterly report (FE-2013012). Ferrous sulfate dispersed in methylnaphthalene has been shown to be reduced to ferrous sulfide under typical coal hydroliquefaction conditions (1 hour, 450°C, 1000 psi). This suggests that ferrous sulfide may be the common catalytic ingredient when either (a) ferrous sulfate impregnated on powdered coal, or (b) finely divided iron pyrite is used as the catalyst. Old research on impregnated ferrous sulfate, impregnated ferrous halides, and pyrite is consistent with this assumption. 12 references, 1 figure, 5 tables.

8110 **(DOE/ET/13702—12) Investigation of carbon monoxide disintegration of refractories in coal gasifiers. Final report, October 1, 1980-September 30, 1983 .** Brown, J.J. Jr. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Materials Engineering). Jul 1984. Contract AC05-80ET13702. 237p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE85001307.

The CO attack on the castables varied with the temperature used. The visible effects, such as carbon deposition, pop-outs, and surface cracking, were more pronounced between 450°C and 500°C. The visible effects were mild at 400°C and 550°C. In the post-reaction analysis of samples, no compounds of iron were detected. All the evidence points to the fact that the metallic iron is the catalyst. CO seems to have a two fold attack on the refractory: (a) strength degradation caused by possibly weakening the bond between the grain and the binder without any visible disintegration and (b) disintegration of the castable by the formation of filamentous carbon which grows throughout the material. For coal gasifier refractories where an appreciable amount of CO is likely to be present, extreme care should be taken to avoid the presence of iron in the castables. Hence, when the CO concentration is high, it is not possible to have iron or steel reinforcement in them. In designing those areas where CO is to be present, the pressure should be as low as possible and the temperature should be above 800°C. The use of 50+wt % alumina is more economical and its resistance to CO disintegration is no less than that of 90+wt % alumina. Moreover, 45 to 55 wt % alumina has shown to increase in strength when exposed to coal gas mixtures containing H_2O.

8111 **(DOE/FE/05122—1668) Measurements and theory of coal pyrolysis.** Solomon, P.R.; Hamblen, D.G. (Advanced Fuel Research, Inc., East Hartford, CT (USA)). Jul 1984. Contract AC21-81FE05122. 168p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85001962.

The pyrolysis literature presents a wide variability among coals in their volatile content, tar and soot production, rate of pyrolysis, swelling and sticking behavior, char reactivity and pollutant formation. There is presently a lack of understanding on which to base a systematic comparison of the data and no accepted method to predict the coal's behavior. The objective of this Topical Report is to present an interpretation of coal pyrolysis which permits a more orderly view of the pyrolysis data. The validity of this view is currently being tested by the development of a detailed pyrolysis model, its implementation in a computer code, the acquisition of pyrolysis data for a wide variety of coals under a wide variety of experimental conditions and the comparison of the model and experiment. The pyrolysis model views coal as an ensemble of functional groups organized into tightly bound aromatic ring clusters connected by weaker aliphatic and either bridges. Thermal decomposition of the coal releases large fragments of the coal molecule (tar) by depolymerization due to rupture of the weak bridges. The rate constants for the release of tar and for the thermal decomposition of the various functional groups depend on the nature of the bridging bond or of the functional group, but appears relatively insensitive to coal rank for lignites, subbituminous and bituminous coals. The important variation with rank is the mix of functional groups. The model predicts the time and temperature dependent evolutions of the products of thermal decomposition using: (1) a coal independent set of kinetic parameters; (2) the coal's functional group composition; (3) the time-temperature history of the coal; and (4) the reactor conditions such as pressure, bed geometry, etc. 78 references, 87 figures, 5 tables.

8112 (DOE/FE/60177—1680, pp 3.1-3.16) **Underground coal gasification: Western Research Institute quarterly technical progress report, April-June 1984.** 15 Aug 1984. NTIS, PC A04/MF A01. File Number DE85000818.

In Oil shale, tar sands, and underground coal gasification. Quarterly progress report, April-June, 1984.

Progress accomplished in in-situ coal gasification during the quarter is summarized. The contract for fabrication of a coal reactor box and modifications to the block reactor apparatus for underground gasification tests is 91% complete. Other construction activities in preparation for the first laboratory UCG test in a solid block of coal are in progress. The flare is installed, and power is available at the main electrical panel. Conduit has been installed from the main panel to the solenoid valves, pump and heat tracing. Equipment has also been assembled to drill the 6-foot long link in the coal blocks. A draft of the material and energy balance software has been prepared and is ready for testing. The postburn drilling, coring, and logging program at the partial seam controlled retraction injection point (CRIP) site was completed. Nineteen bore holes were drilled to delineate the affected regions of the coal and overburden resulting from a UCG test. An effort was initiated to identify alternate uses for energy generated from UCG technology. Research continued on development of an analytical method to detect low concentrations of phenols in water with and without extraction or prior concentration. Solid extraction and exchange absorption methods are being used to isolate key indicator compounds in UCG waters. Efforts were focused on hydroxypyridines. The Hoe Creek hydrologic testing field work was completed in May 1984. Based on current knowledge of ground water flow direction, ten additional well locations have been proposed for the site. Data entry of water quality information from the Hanna and Hoe Creek sites was reinitiated this quarter. Three groundwater contaminant migration computer models have been applied to the Hanna site data. A 2190-gallon water sample was collected from the cavities in the Hanna UCG test site for biological studies. 3 figures, 2 tables.

8113 **(DOE/MC/19122—1684) Advanced development of a pressurized ash agglomerating fluidized-bed coal gasification system. Second quarter progress report FY-1983, January 1-March 31, 1983.** (Westinghouse Electric Corp., Madison, PA (USA). Synthetic Fuels Div.). 16 May 1983. Contract AC21-82MC19122. 51p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85004045.

The overall objective of the Westinghouse coal gasification program is to demonstrate the viability of the Westinghouse pressurized, fluidized bed, gasification system for the production of medium-Btu fuel gas for syngas, electrical power generation, chemical feedstocks, or industrial fuels and to obtain performance and scaleup data for the process and hardware. Accomplishments for the quarter are presented for the following tasks: (1) process development unit test operations and results; (2) process analysis; (3) cold flow scaleup facility; (4) process and component engineering and design; and (5) laboratory support studies of gas-solids flow modeling and coal/ash behavior. 8 figures, 11 tables.

8114 **(DOE/MC/19163—1687) Great Plains Model Development: oxygen plant flowsheet. Final report.** Stern, S.S. (Scientific Design Co., Inc., New York (USA)). Nov 1984. Contract AC21-82MC19163. 266p. NTIS, PC A12/MF A01; GPO Dep. File Number DE85003203.

An ASPEN model has been developed of the Oxygen Plant, Section 3000, of the Great Plains Gasification Plant. The bases for this model are the process description given in Section 6.16 of the Great Plains Project Management Plan, Lummus Oxygen Plant Schematic Process Flow Diagram, Dwg. No. SK D-7102-IK-2, and US Patent 3,947,259. The ASPEN model that has been developed considers only the components oxygen, nitrogen, argon, carbon dioxide, and water. The simulation was split into two models: (1) the complete flowsheet including the cold box without spray drying; and (2) the front end with spray drying and no cold box. The models are primarily flowsheet simulations which will give the material and energy balances and the equipment duties for a given set of process conditions. The model is unable to predict changes in process conditions that would result from load changes on equipment of fixed sizes, such as a rating model would. The model can be used for simulating the steady-state operation of the plant at or near design conditions, or in designing other oxygen plants. Both steam and cooling water requirements are calculated as part of the simulation. Several major process assumptions had to be made in the development of the flowsheet model because of the limited

process information available. Among the most significant assumptions were the number of theoretical stages and operating conditions for the low and high pressure towers, the expander inlet temperature, and the warm end temperature difference. A complete list of assumptions can be found in Table 2. 49 references.

8115 **(DOE/MC/19163—1688) Great Plains model development: gas compression and drying section. Final topical report.** Stern, S.S. (Scientific Design Co., Inc., New York (USA)). Nov 1984. Contract AC21-82MC19163. 111p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85002887.

An ASPEN model has been developed of the Gas Compression and Drying Flowsheet, Section 1900, of the Great Plains Gasification Plant. The basis for this model is the process description given in section 6.14 of the Great Plains Project Management Plan, and the Lummus Schematic Process Flow Diagram, Dwg. No. SK D-7102-IJ-2. The TEG Drying section is a standard adsorbing and stripping operation. Operating conditions for the towers were obtained from the Gas Condition Fact Book published by the Dow Chemical Company. The ASPEN model that has been developed uses an abbreviated list of components, since not all the components appear in the product. Furthermore, since a Henry's Law model with Wilson activity coefficients is used to predict vapor/liquid equilibrium, it would have required a large effort to enter the Henry's Law parameters for all the components that ultimately would not be used because they are not found in the product streams. The model is primarily a flowsheet simulation that will give the material and energy balances and equipment duties for a given set of process conditions. The model is unable to predict fully changes in process conditions that would result from flow load changes on equipment of fixed sizes, such as a rating model would. The model can be used to simulate the steady-state operation of the plant at or near design conditions, or to design other Gas Compression and Drying Systems. TEG flowrate is varied to meet the water specification in the product gas. No convergence problems were experienced running the model. Several runs were made to study the response of the model to changes in the feed flowrate, product specification, and number of trays in the absorber. 5 references.

8116 **(DOE/MC/19265—1671) Review of ash agglomeration in fluidized bed gasifiers.** Matulevicius, E.S.; Golan, L.P. (BDM Corp., McLean, VA (USA); Exxon Research and Engineering Co., Florham Park, NJ (USA)). Jul 1984. Contract AC21-82MC19265. 146p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85001971.

The purpose of this study is to review the data and mathematical models which describe the phenomena involved in the agglomeration of ash in fluidized bed coal gasifiers (FBG). Besides highlighting the data and theoretical models, this review lists areas where there is a lack of information regarding the actual mechanisms of agglomeration. Also, potential areas for further work are outlined. The work is directed at developing models of agglomeration which could be included in computer codes describing fluidized bed gasifier phenomena, e.g., FLAG and CHEMFLUB which have been developed for the US Department of Energy. 134 references, 24 figures, 13 tables.

8117 **(DOE/MC/19265—1672) Testing, evaluation, and validation of detailed mechanistic codes for fluidized bed gasifiers. Final report.** (BDM Corp., McLean, VA (USA); Exxon Research and Engineering Co., Florham Park, NJ (USA)). Sep 1984. Contract AC21-82MC19265. 172p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85001970.

To support its experimental fluidized bed coal gasification program, DOE has sponsored the development of detailed mathematical models of gasification reactors. The purpose of these models is to provide insight into the process occurring with the reactors and to investigate the effects of reactor design on the performance of the fluidized bed. Successfully achieving these objectives would provide the capability to investigate the scale-up of pilot plant reactors and to optimize the coal gasification process through parametric studies. Two of these models are embodied in the computer codes CHEMFLUB and FLAG. The BDM Corporation was retained by the Morgantown Energy Technology Center of DOE to verify, evaluate, and document the CHEMFLUB and FLAG codes. This report consists of a description of BDM's experience with the FLAG and CHEMFLUB codes. Chapter 2 describes the results for CHEMFLUB and Chapter 3 describes the results for FLAG. The results of the test case runs were reported in detail via the monthly reports. We have reiterated this data here in the final report. For the sake of clarity and reading convenience, lengthy tables have been postponed to appendices. Since each code responded differently to the initial test cases, each code was tested in a slightly different manner. Test cases were performed which were appropriate to the apparent difficulty manifested by each code.

8118 **(DOE/MC/19265—1673) Literature and data review and compilation. Final topical report.** Matulevicius, E.S.; Golan, L.P.; Heard, W.B.; Bhagat, P.M.; Segev, A. (BDM Corp., McLean, VA (USA); Exxon Research and Engineering Co., Florham Park, NJ (USA)). Jun 1984. Contract AC21-82MC19265. 130p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85001969.

The purpose of this review is to provide a database for the evaluation and validation of mathematical codes describing fluidized bed gasifiers. This review was prompted by the need to evaluate two numerical codes, CHEMFLUB and FLAG, developed under Department of Energy sponsorship. Because of fundamental nature of the codes, they may possibly be used as a potential method for minimizing the cost and time required to develop and commercialize fluidized bed gasifiers. In order to have the confidence that these codes can accurately predict fluidization and gasification phenonmena, a logical and systematic comparison of the codes against key correlations is required. This review contains the necessary data and correlations for this evaluation. Previously developed computer models of fluidized bed gasifiers are empirical in nature. Hence, they are useful only in regions where the assumptions are valid. On the other hand, CHEMFLUB and FLAG begin with a fundamental description of the fluid mechanics, chemistry and heat transfer relationships. Because of this, there is promise that these models could be used in areas where experimental information is not readily available, to address issues of scale-up, and to examine transient phenomena often associated with operating and safety issues. In order to have confidence that the models are able to predict gasifier behavior, it is necessary that key physical parameters be efficiently and accurately calculated. This review divides the database required into two major areas, gasification kinetics, and fluidization behavior. The review is not intended to critically analyze all the information in the literature. Rather, it is a selective review of the literature, tailored to provide the necessary data to evaluate and validate the codes. 215 references.

8119 **(DOE/MC/19265—1674) FLAG: a computer code model for fluidized bed coal gasification reactors. Volume I. Technical document.** Goldman, A. (BDM Corp., McLean, VA (USA)). Apr 1984. Contract AC21-82MC19265. 115p. NTIS, PC A06/MF A01; GPO Dep. File Number DE85001966.

This is the first volume in a three volume set which will explain various aspects of the FLAG code. This volume sets forth the basic differential equations used to model a reacting fluid-particle system and then presents the numerical procedures used to solve the differential equations. The basic philosophy employed has been to simply state what has been programmed in the FLAG code. For a number of points just showing an equation provides everything necessary to understand what has been done. However, for other aspects of the code an equation presented outside the context of the development has little meaning. In these instances enough of the developpment has little meaning. In these instances enough of the development is given to make the equations meaningful, but the full detailed step by step development which produced the equation is not given. That level of detail is left to the references. A second point to keep in mind is that the coding in FLAG does not necessarily have a one to one correspondence to the equations given here. For example, equation (1.1-1) shows calculation of a variable composed of the sum of three quantities $q = q_1 + q_2 + q_3$. Within FLAG the quantities q_1, q_2, and q_3 may each be created in different subroutines and with a variable name different from that shown in (1 1-1). Therefore, FLAG may contain three FORTRAN state-

ments of the form q = q + r rather than the one equation given by (1.1-1). Thus, the equations coded in FLAG are not always recognizable as those shown in this volume. 12 references, 12 figures.

8120 **(DOE/MC/19265—1675) FLAG: a computer code model for fluidized bed coal gasification reactors. Volume II. User's manual.** Goldman, A. (BDM Corp., McLean, VA (USA)). Jun 1984. Contract AC21-82MC19265. 57p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85001967.

The ideas associated with FLAG can logically be divided into the three general catagories of theory, structure, and use. Theory represents the information surrounding the physical and mathematical models and the computational techniques used to solve the mathematical models. Structure represents the details of the algorithms which are used to translate the theory in lines of code. Use represents the instructions required to run the code. Volume I, the Technical Manual, contains the theory and Volume III, the Systems Manual, contains the details of structure of the code. This volume, the User's Manual, contains the instructions on how to operate FLAG. In general, this volume treats FLAG as a black box, i.e., it is only necessary to know how to input information and understand the output, but it is not necessary to know or understand the inner workings of the code. Nevertheless, there are two exceptions to this. The first exception comes about when a required input parameter is directly related to theory and can only be explained within that context. The second exception comes about because output is generated throughout the code and some knowledge of the structure is needed to interpret the results. Information from Volume I and Volume III has been reproduced here when it helps clarify these issues. The appendices contain a sample data file and sample JCL for compiling and executing the code on a Digital Corporation, VAX 11/780 computer system. The output presented in the figures given in this volume was generated using the sample data with the system configured according to the sample JCL. It has been assumed that a systems programmer will configure the JCL specifically for the system on which FLAG is to run, thus the details of the JCL are given in Volume III. 8 figures, 9 tables.

8121 **(DOE/MC/19265—1676) FLAG: a computer code model for fluidized bed coal gasification reactors. Volume III. Systems manual.** Goldman, A. (BDM Corp., McLean, VA (USA)). Sep 1984. Contract AC21-82MC19265. 162p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85001968.

This is the third and final volume of a set of reports to describe the theory and construction of the FLAG code. The first volume is devoted to a presentation of the mathematical model to describe a coal gasifier and an explanation of the computational methods used to solve these equations. The second volume is devoted to an explanation of how to use the FLAG code. This final volume provides information on the hardware and system requirements necessary to run the code and details on its internal structure. There is, of course, some overlap in these volumes. Some of the input variable described in Volume II can be understood only through the methodology given in Volume I. In addition, running the code also requires knowledge of JCL, which is part of this volume. Thus, some of the same information is repeated in each of the volumes. Nevertheless, there is a major difference between this volume and the first two volumes. This volume is intended primarily for an individual to bring up the code and make changes to the code. Following the introduction, chapter II provides information concerning the hardware and JCL necessary to implement the code. A number of computer systems are not suitable for FLAG; this is the type of information given in that chapter. Chapter III details the data blocks and variables used throughout the code. This information is most important for modifying the code because it specifies where in the code quantities are created. Chapter IV provides a description of modules and subroutines that make up FLAG. This chapter provides more detail on the actual structure of the code. 2 figures, 91 tables.

8122 **(DOE/MC/19265—1677) CHEMFLUB: a computer code model for fluidized bed coal gasification reactors. Volume I. Technical document.** Mitchell, D. (BDM Corp., McLean, VA (USA)). May 1984. Contract AC21-82MC19265. 134p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85001972.

This report is the result of an analysis of the CHEMFLUB code. The mathematical formulation of the models for the motion of fluids and particles is discussed. In addition, the closure equations and chemistry models are reviewed. The method of solution of these equations is analyzed. The stability and convergence criteria in CHEMFLUB are also presented. The solution algorithms for each portion of the system of equations are discussed. The overall solution technique which is based on these algorithms is presented in section D and table III-9 in Chapter III. Those desiring a concise explanation of the CHEMFLUB methodology should review these portions of Chapter III first. CHEMFLUB is a sparsely documented and unique computer code. For example, it uses a steady-state gas momentum equation to describe a time dependent problem. As a result, this document is not intended to justify the algorithms used in CHEMFLUB but simply to explain what the code does. Finally the method used in CHEMFLUB to set up the solution grid and establish boundary conditions are described. 7 references, 17 figures, 10 tables.

8123 **(DOE/MC/19265—1678) CHEMFLUB: a computer code model for fluidized bed coal gasification reactors. Volume II. User's manual.** Mitchell, D. (BDM Corp., McLean, VA (USA)). Jul 1984. Contract AC21-82MC19265. 145p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85001964.

This manual is the result of a detailed analysis of the CHEMFLUB code. The first portion, Chapter II, consists of a description of the variables needed to run CHEMFLUB and output variables which contain the results produced by the code. Chapter III provides all of the information needed to run CHEMFLUB including setting of input variables, printing output options, constructing the calculation mesh and restarting a previous calculation. The next section, Chapter IV, is a detailed discussion of the code operation; followed by Chapter V which contains the flow charts of CHEMFLUB. Chapter VI discusses the diagnostic messages currently contained in CHEMFLUB to alert the user to incorrect input conditions, calculation problems, etc. Chapter VII consists of the results of using CHEMFLUB to perform a calculation. The sample problem is discussed, the input used for the problem is shown, and the generated output is provided so that a user can verify the results produced by operating the code. The file needed to restart the calculation and the output produced are also included. The information gained from using CHEMFLUB is summarized in Chapter VIII so its limitations and capabilities can be better understood by users. 4 references, 8 figures, 22 tables.

8124 **(DOE/MC/19265—1679) CHEMFLUB: a computer code model for fluidized bed coal gasification reactors. Volume III. Systems manual.** Mitchell, D. (BDM Corp., McLean, VA (USA)). Sep 1984. Contract AC21-82MC19265. 220p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE85001965.

The purpose of this Systems Manual is to provide detailed material and descriptions relating to the structure and operation of the CHEMFLUB computer code. It is prepared for computer scientists, systems level analysts, and programmers whose responsibilities include modifications to the computer code, solution of program/system problems, etc. This volume is not being written for the physcists or engineers who want to use CHEMFLUB. They should refer to Volume I - Technical Document and Volume II - Users' Manual. Chapter II provides an overall systems view of CHEMFLUB including the basic input/output file structure, restart requirements and diagnostic messages contained in the code. This is followed by Chapter III which covers the data and variables used in CHEMFLUB. Included are descriptions of the common blocks, initialization data, parameter statements, and key variables. The subroutines in CHEMFLUB are described in Chapter IV. The function of each subroutine is presented and related to flow charts of the five major subsections of the code. The primary outputs of each subroutine are also provided. The command file necessary for executing CHEMFLUB is discussed in Chapter V. The process of setting up and initiating a CHEMFLUB calculation is described by referring to the command file. Chapter VI describes a general method for modifying CHEMFLUB and making changes and additions to the code. 8 figures, 10 tables.

8125 (DOE/MC/20468—1645) **Investigation of non-intrusive radiometers for entrained gasifier temperature measurement. Second quarterly report, February 1, 1984-April 30, 1984.** Fairchild, P.; Gat, N.; Witte, A.B. (TRW, Inc., Redondo Beach, CA (USA). Applied Technology Div.). 18 Jun 1984. Contract AC21-83MC20468. 19p. (TRW-SN—39146). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84016324.

The emphasis during the second quarter has been directed toward the detailed design of the SLEP (Sodium Line Emission Pyrometer) system. Signal-to-noise calculations indicate a better than 1000:1 ratio should be obtained under the expected operating conditions. Five optical access port concepts were evaluated. The optical/mechanical designs of the selected concept are shown for the water-cooled, gas-purged probe, as well as for the etalon spectrometer. The data acquisition system, using an OMA, is also discussed. Following the completion of the design, purchase orders for the various subsystem and components were sent out. As these orders begin to arrive, the assembly, system checkout, and lab test will be performed in the third quarter of the contract. 9 figures, 1 table.

8126 (DOE/METC—84/4, pp 5-7) **Background and overview of the electroslag component casting project.** Hobday, J.M. (Morgantown Energy Tech. Center, WV). Mar 1984. NTIS, PC A11/MF A01. File Number DE84003075. (CONF-8306237—).

From Symposium on electroslag component casting; Morgantown, WV, USA (1 Jun 1983).

A review of the electroslag component casting project is presented. The purposes of the review are to (1) provide the industrial sector with a status report on the state of the art of electroslag casting, (2) identify technical barriers to industry adoption and promotion of the technology, (3) outline the presently planned program, and (4) obtain industry recommendations for program content.

8127 (DOE/METC—84/4, pp 9-14) **Description of electroslag processes (remelting, welding, and casting).** Heestand, R.L. (Oak Ridge National Lab., TN). Mar 1984. NTIS, PC A11/MF A01. File Number DE84003075. (CONF-8306237—).

From Symposium on electroslag component casting; Morgantown, WV, USA (1 Jun 1983).

The electroslag melting technique has been adapted to several different processes for specific applications. Electroslag remelting, electroslag welding, and electroslag casting processes and their relationships are briefly described.

8128 (DOE/METC—84/4, pp 15-39) **Electroslag casting production techniques.** Mitchell, A. (Univ. of British Columbia, Vancouver). Mar 1984. NTIS, PC A11/MF A01. File Number DE84003075. (CONF-8306237—).

From Symposium on electroslag component casting; Morgantown, WV, USA (1 Jun 1983).

The electroslag remelting process has become an accepted method of producing high-quality ingots in a variety of steels and related alloys. The advantages, disadvantages, and performance of the process are discussed.

8129 (DOE/METC—84/4, pp 41-56) **Status of electroslag casting technology: a worldwide perspective.** Bhat, G.K. (Mellon Inst., Pittsburgh, PA). Mar 1984. NTIS, PC A11/MF A01. File Number DE84003075. (CONF-8306237—).

From Symposium on electroslag component casting; Morgantown, WV, USA (1 Jun 1983).

The status of electroslag casting technology throughout the world is reviewed. Electroslag casting technology is on the increase with even the developing countries taking an interest in it.

8130 (DOE/METC—84/4, pp 57-95) **Electroslag processing at the Oregon Graduate Center.** Wood, W.E. (Oregon Graduate Center, Beaverton). Mar 1984. NTIS, PC A11/MF A01. File Number DE84003075. (CONF-8306237—).

From Symposium on electroslag component casting; Morgantown, WV, USA (1 Jun 1983).

The objectives of the research on electroslag processing at the Oregon Graduate Center are discussed. The objectives include the control of the process, reliability, and mechanical properties of the electroslag-welded structural steels.

8131 (DOE/METC—84/4, pp 97-142) **Mechanical properties of electroslag castings.** Sikka, V.K. (Oak Ridge National Lab., TN). Mar 1984. NTIS, PC A11/MF A01. File Number DE84003075. (CONF-8306237—).

From Symposium on electroslag component casting; Morgantown, WV, USA (1 Jun 1983).

The mechanical properties of electroslag castings determined at the Oak Ridge National Laboratory are described. The materials that were used in the casting process were 2 1/4 Cr-1 Mo and the stainless steels. The 18-8 or the CF8M composition was selected because it is more castable. It was found that the surface finish of electroslag castings was of good quality and that tensile, Charpy, and creep properties of the castings were similar to those of sand castings with similar ferrite numbers.

8132 (DOE/METC—84/4, pp 143-151) **Microstructural characterization of electroslag castings.** Patterson, B.R. (Univ. of Alabama, Birmingham). Mar 1984. NTIS, PC A11/MF A01. File Number DE84003075. (CONF-8306237—).

From Symposium on electroslag component casting; Morgantown, WV, USA (1 Jun 1983).

Some of the easily determined microstructural characteristics that affect the properties of many alloys are discussed. The goal of this work was to characterize the microstructures of several CF8M sand and electroslag castings. By determining how the methods of processing affect the microstructure and how the micro-structure controls properties, a better understanding of the relationships between processing and mechanical properties of many alloys may be obtained. This work was an attempt to determine some structure-property-processing relationships in order to better understand how to optimize and maintain consistent properties through processing.

8133 (DOE/METC—84/4, pp 187-205) **Economics of electroslag casting techniques.** Mitchell, A. (Univ. of British Columbia, Vancouver). Mar 1984. NTIS, PC A11/MF A01. File Number DE84003075. (CONF-8306237—).

From Symposium on electroslag component casting; Morgantown, WV, USA (1 Jun 1983).

The economics of electroslag casting is discussed. The economic analysis is presented for a shop that contains three electroslag casting furnaces. It was found that conventional sand casting cost $2.90/lb and that electroslag casting costs $1.50/lb.

8134 (DOE/METC—84/4, pp 207-218) **Description of the surface gasification materials program electroslag component casting project plan.** Judkins, R.R. (Oak Ridge National Lab., TN). Mar 1984. NTIS, PC A11/MF A01. File Number DE84003075. (CONF-8306237—).

From Symposium on electroslag component casting; Morgantown, WV, USA (1 Jun 1983).

The electroslag component casting project is described. There are four major goals of the electroslag components casting projects: (1) process improvement and optimization, (2) application for ASME Code approval, (3) education and technology transfer, and (4) the manufacture of pilot components and obtaining industrial experience with them. Each of these goals is discussed.

8135 (DOE/OR/03054—47) **Internal R and D task summary report: reactor yields.** Givens, E.N.; Joshi, S.V.; Kang, D.; Sivasubramanian, R.; Skinner, R.W.; Ying, D.H.S. (International Coal Refining Co., Allentown, PA (USA)). Sep 1983. Contract AC05-78OR03054. 448p. NTIS, PC A19/MF A01; 1; GPO Dep. File Number DE85004494.

This report summarizes all R and D work performed under the SRC-I Demonstration Plant Contract to support design of the plant's SRC reaction area. The work was initially conducted by Air Products and Chemicals, Inc. (APCI), and continued by International Coal Refining Co. (ICRC). A background of the basic experimental techniques is provided, plus an analysis of the statistical sig-

nificance of the product work-up methods. The key to the experimental procedure was the use of continuous stirred tank reactors, which are described in detail. The effects of process variables such as temperature, total pressure as well as hydrogen partial pressure, residence time, and solvent type are discussed in general. Also, extensive coverage is provided for the following areas: the effect of dissolver solids on conversion and product distribution; the effect of staged dissolvers on performance; the impact of including SRC recycle in the design; and an in-depth evaluation of the effect of reactor hydrodynamics on conversion and product distribution. A comparison of bench-scale and Wilsonville pilot plant data is presented. Finally, a discussion of the impact of this laboratory data on the plant design is presented. 25 references, 155 figures, 103 tables.

8136 **(DOE/OR/03054—T35) Post-baseline Environmental R and D Plan, SRC-I project.** (International Coal Refining Co., Allentown, PA (USA)). 10 Dec 1982. Contract AC05-78OR03054. 30p. NTIS, PC A03. File Number DE85001617.

8137 **(DOE/OR/21486—T2) ASPEN PLUS modeling of the SRC-I Demonstration Plant. Task 2: SRC unit detailed model report.** Kalb, C.E.; Guro, D.E.; Bixler, A.D.; Vakil, T.D. (Air Products and Chemicals, Inc., Allentown, PA (USA)). 28 Sep 1984. Contract AC05-84OR21486;AC05-78OR03054. 112p. (DOE/OR/03054—T36). NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85004620.

A detailed model of the SRC process areas of the SRC-I Demonstration Plant was developed using the ASPEN PLUS process simulator. The model permits, for the first time, steady-state flowsheet convergence for the entire SRC process area in a single computer run. Simulation results are presented based on new thermodynamic correlations derived from experimental data on coal liquids. The correlations predict separations in certain key vessels which are rather different from those in the current SRC-I Baseline Design, which was based on conventional petroleum thermophysical properties. The differences are discussed in-light of their effects on equipment configuration and size. Distillation column parameters were adjusted to maintain the purity specifications of the major product streams. Split fractions based on the coal-liquids results are presented which can be used in the Task 1 SRC area summary model. Notes: Task 2, Appendices 2 is DOE/OR/21486—T8. 5 references, 32 tables.

8138 **(DOE/OR/21486—T3) ASPEN PLUS modeling of the SRC-I Demonstration Plant. Task 4: CSD summary model and SRC detailed model integration.** Li, T.C. (Air Products and Chemicals, Inc., Allentown, PA (USA)). 28 Sep 1984. Contract AC05-84OR21486;AC05-78OR03054. 70p. (DOE/OR/03054—T37). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85003807.

This report summarizes Task 4 of the ASPEN PLUS Modeling Project performed by APCI to simulate a complete, single, integrated model comprising the individual model from Task 2 along with a summary model of the CSD Unit adapted from the summary model of this unit developed for Task 1. The simulation of the CSD/SRC integration is based on an upgraded coal-liquid data base. This report documents the Program Input File and the Simulation Results. This report also outlines the comparison of the results with the corresponding heat and material balances contained in the Design Baseline.

8139 **(DOE/OR/21486—T4) ASPEN PLUS modeling of the SRC-I Demonstration Plant. Task 1, Appendix 1A: SRC-I facility summary model report. Volume 2.** Vakil, T.D. (Air Products and Chemicals, Inc., Allentown, PA (USA)). 28 Sep 1984. Contract AC05-84OR21486;AC05-78OR03054. 436p. (DOE/OR/03054—T38). NTIS, PC A19/MF A01; 1; GPO Dep. File Number DE85004616.

8140 **(DOE/OR/21486—T5) ASPEN PLUS modeling of the SRC-I Demonstration Plant. Task 1, Appendix 1A: SRC-I facility summary model report. Volume 3.** Vakil, T.D. (Air Products and Chemicals, Inc., Allentown, PA (USA)). 28 Sep 1984. Contract AC05-84OR21486;AC05-78OR03054. 474p. (DOE/OR/03054—T39). NTIS, PC A20/MF A01; 1; GPO Dep. File Number DE85004621.

8141 **(DOE/OR/21486—T6) ASPEN PLUS modeling of the SRC-I Demonstration Plant. Task 1, Appendix 1B: SRC-I facility summary model. Volume 1.** Vakil, T.D. (Air Products and Chemicals, Inc., Allentown, PA (USA)). 28 Sep 1984. Contract AC05-84OR21486;AC05-78OR03054. 516p. (DOE/OR/03054—T40). NTIS, PC A22/MF A01; 1; GPO Dep. File Number DE85004615.

8142 **(DOE/OR/21486—T7) ASPEN PLUS modeling of the SRC-I Demonstration Plant. Task 1, Appendix, 1B: SRC-I facility summary model. Volume 2.** Vakil, T.D. (Air Products and Chemicals, Inc., Allentown, PA (USA)). 28 Sep 1984. Contract AC05-84OR21486;AC05-78OR03054. 586p. (DOE/OR/03054—T41). NTIS, PC A25/MF A01; 1; GPO Dep. File Number DE85004619.

8143 **(DOE/OR/21486—T8) ASPEN PLUS modeling of the SRC-I Demonstration Plant. Task 2, Appendix 2: SRC unit detailed model report.** Kalb, C.E.; Guro, D.E.; Bixler, A.D.; Vakil, T.D. (Air Products and Chemicals, Inc., Allentown, PA (USA)). 28 Sep 1984. Contract AC05-84OR21486;AC05-78OR03054. 454p. (DOE/OR/03054—T42). NTIS, PC A20/MF A01; 1; GPO Dep. File Number DE85004614.

8144 **(DOE/OR/21486—T9) ASPEN PLUS modeling of the SRC-I Demonstration Plant. Task 4, Appendix 4: integrated SRC area model report .** Li, T.C. (Air Products and Chemicals, Inc., Allentown, PA (USA)). 28 Sep 1984. Contract AC05-84OR21486;AC05-78OR03054. 456p. (DOE/OR/03054—T43). NTIS, PC A20/MF A01; 1; GPO Dep. File Number DE85004625.

8145 **(DOE/OR/21486—T10) ASPEN PLUS modeling of the SRC-I Demonstration Plant. Task 19: modeling support activities report.** (Air Products and Chemicals, Inc., Allentown, PA (USA)). 28 Sep 1984. Contract AC05-84OR21486;AC05-78OR03054. 501p. (DOE/OR/03054—T44). NTIS, PC A22/MF A01; 1; GPO Dep. File Number DE85004624.

The APCI version of ASPEN PLUS was maintained and enhanced in order to support the requirements of the simulation effort described in the earlier tasks. The support effort is conveniently divided into systems support and technical support in the areas of flowsheeting and thermophysical properties. Systems support required installation of the fourth release of ASPEN PLUS, installation of AspenTech's updates to correct program errors, and several general maintenance tasks unique to the APCI version of ASPEN PLUS. Technical support in the area of flowsheeting consisted of the organization of training courses, consultation in solving simulation problems, and identifying and resolving problems resulting from bugs in ASPEN PLUS. Thermodynamic technical support consisted of developing a few new models, implementing the coal-fluid thermophysical models into ASPEN PLUS, providing convenient access to the physical properties through INSERTs, and consultation to resolve simulation problems resulting from the nonideality of the properties. All software enhancements to ASPEN PLUS have been described and delivered so that APCI's version of the program may be duplicated and maintained at other sites. 16 references.

8146 **(DOE/OR/21486—T11) ASPEN PLUS modeling of the SRC-I Demonstration Plant. Task 20: reactor correlation development report.** (Air Products and Chemicals, Inc., Allentown, PA (USA)). 28 Sep 1984. Contract AC05-84OR21486;AC05-78OR03054. 102p. (DOE/OR/03054—T45). NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85004626.

This report details the development of a Revised Kinetic Model (coal liquefaction) for the ASPEN modeling program which correlates the data from ICRC labs. These correlations take into account the impact of hydrogen partial pressure, reactor temperature, slurry residence time, and coal feed variation for Kentucky coal. The predictions of the model agree with data from the Ft. Lewis and Wilsonville Pilot Plants and ICRC lab data within the analytical accuracy of the data. The coding required to implement this model into the ASPEN program is provided.

8147 **(DOE/OR/21486—T13) ASPEN PLUS modeling of the SRC-I Demonstration Plant. Task 1, Appendix 1B: SRC-I facility summary model report. Volume 3.** Vakil, T.D. (Air Products and Chemicals, Inc., Allentown, PA (USA)). 28 Sep 1984. Contract AC05-84OR21486;AC05-78OR03054. 589p. (DOE/OR/03054—T47). NTIS, PC A25/MF A01; 1; GPO Dep. File Number DE85004622.

8148 **(DOE/PC/40782—T8) Desulfurization with transition metal catalysts. Quarterly technical progress report, September 27-December 27, 1981.** Eisch, J.J. (State Univ. of New York, Binghamton (USA). Dept. of Chemistry). 1982. Contract FG22-81PC40782. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004211.

During the first quarter of this new two-year grant the research was reoriented toward desulfurization and denitrogenation of coal-derived fuels and the discovery of efficient catalysts for this purpose. Desulfurization of coal liquids (SRC M-51) with $(COD)_2Ni$, bipyridyl and $LiAlH_4$ in THF at 55°C succeeded. When the proportion of nickel reagent used was equal to twice the organic sulfur content (0.5%), the sulfur was reduced to 0.3%. Desulfurization of various aryl sulfides was also successful with $(COD)_2Ni$, bipyridyl and $LiAlH_4$. A potent desulfurizing agent, $(C_8H_{12})(C_8H_{13})Co$ which does not require bipyridyl for activation was discovered. A variety of molybdenum complexes, with and without metal hydride bonds led to only moderate desulfurization of dibenzothiophene. Preliminary work was initiated on denitrogenation of coal liquids by examining the behavior of quinoline and carbazole.

8149 **(DOE/PC/60783—5) Study of the kinetics of hydrogenation using aged catalysts. Quarterly technical progress report, July 1-September 30, 1984.** Schweighardt, F.K. (Air Products and Chemicals, Inc., Allentown, PA (USA)). Oct 1984. Contract FG22-83PC60783. 25p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004374.

During this quarter, microautoclave testing was completed to establish optimum operating conditions for the conversion of pyrene to dihydropyrene. It was determined that 350°C at 600 to 1000 psig hydrogen over 0 to 120 minutes generated substantially dihydropyrene with hexadecane solvent in the presence of Shell 324M NiMo catalyst. By applying the kinetics of H.P. Stephans (Sandia Labs) to the pyrene hydrogenation, it was possible to differentiate the reactivity between three catalyst samples: fresh presulfided, aged 116 SRC/catalyst, and aged 1459 SRC/catalyst. The reaction conditions and work-up procedures developed during this quarter will be applied to the 1-liter automated Robinson reactor for the remainder of this study. 20 references, 7 figures, 1 table.

8150 **(DOE/PE/70151—T6) Economic analyses of synfuel incentives. Final report.** (TRW, Inc., McLean, VA (USA). Energy Systems Group). 12 Feb 1980. Contract AC01-79PE70151. 37p. NTIS, PC A03. File Number DE85004062.

A series of computer calculations involving the effect of various financial incentives on the price of synthetic and synthetic transportation fuels is provided. The assumptions in the calculations are listed. (LTN)

8151 **(DOE/PETC/TR—85/4) Operation of a coal liquefaction PDU with full gas and liquid recycle capability: effect of superficial gas velocity in reactor.** Klunder, E.B.; Mima, J.A.; Krastman, D. (USDOE Pittsburgh Energy Technology Center, PA). 1985. 84p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85004576.

SRC-II liquefaction yield structures were obtained in an 1000 lb (coal) per day liquefaction PDU when operated at typical SRC-II reactor conditions. The PDU is distinguished from Gulf units by a tall reactor design (24m) that allowed operation at commercial superficial gas velocities. Liquefaction of Blackville No. 2 coal demonstrated a significantly improved selectivity toward distillate relative by hydrocarbon gas make, however, when the gas velocity was raised to 0.18 m/sec, the highest value tested, and the nominal residence time was increased to 1.5 hr. The efficiency of hydrogen utilization improved from 7.6 kg distillate yield/kg H_2 consumed at conventional SRC-II conditions to 11.4 kg distillate/kg H_2 under the most favorable PDU conditions. 37 references, 24 figures, 15 tables.

8152 **(GAO/RCED—84-85) Status of the Great Plains coal gasification project, May 31, 1984.** (General Accounting Office, Washington, DC (USA). Office of the Comptroller General). 18 Sep 1984. 20p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760. File Number TI85900501.

Report to the Congress.

The Great Plains coal gasification project in North Dakota was 99 percent complete and essentially on schedule on May 31, 1984. Cumulative project costs were $164 million less than originally estimated for this date, primarily due to reduced material, interest, and subcontractor costs. On the basis of reduced energy price forecasts, Great Plains in September 1983 projected large after-tax losses and negative cash flows from plant operations. To alleviate these losses, Great Plains applied to the US Synthetic Fuels Corporation for additional financial assistance. On April 26, 1984, the Corporation outlined its intentions to award Great Plains up to $790 million in assistance. As of August 10, 1984, the Corporation had not finalized the Great Plains assistance agreement.

8153 **(NP—5750429) Industrial gas generators.** Syltevik, D. (Norsk Dampkjelforening, Oslo). Apr 1982. 93p. (In Norwegian). NTIS (US Sales Only), PC A05/MF A01. File Number TI85750429.

Coal gasification and some processes are described. The choice of gasifier is normally restricted by available coal quality, or vice versa. Several coal gas applications are discussed. Most likely applications in Norway are in the production of synthesis gas and the production of generator gas for combustion (less than 10MW each). The cost of clean generator gas can be competitive with fuel oil. Combustion of hot raw gas should give a saving. Healthy economy depends on constant full utilization of the installed effect. Gas generators are therefore most economical in production units and when used to cover the base load. Part B of this report is a feasibility study, convering a 8MW fired production unit from light fuel oil to clean generator gas. Return on investment was found to be 3% p.a.. 25 drawings, 11 tables.

8154 **(NP—5770032) Importance of coal chemistry.** Franck, H.G. (Ruhrkohle A.G., Essen (Germany, F.R.)). 1984. 29p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number TI85770032.

The fundamentals of coal chemistry, especially coal tar chemistry, coking, gasification, and liquefaction processes were discussed, including historical aspects. On the basis of the processes developed coal can be transformed into petroleum type products. Fuels, heating oils and chemical feedstocks can be produced.

8155 **(NP—5770048) Studies on the rheological properties of hard coal-binder mixtures within the plastic range of hard coals.** Hopmann, E. (Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Fakultaet fuer Bergbau, Huettenwesen und Maschinenwesen). 3 Jun 1983. 174p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number TI85770048.

The quality of binders and the influence of coal-dependent parameters such as intertinite, residual caking power, degree of oxidation, ash content and course of coking on the coking properties of mixed systems of coal and binders were studied. Differences between low and high volatile coals, the influence of the proportion of binder, and the grain size of the coals were determined. The Gieseler plastometer, the Ruhr dilatometer, the Roga test and microscopical methods were applied.

8156 **(NP—5770050) Rapid pyrolysis of powdered brown coals in a chemical shock tube.** Frieske, H.J. (Technische Hochschule Aachen (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet). 22 Jul 1982. 111p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number TI85770050.

Pyrolysis is one of the first steps in the valorification of ballast-rich brown coals. The products of pyrolysis and their formation at high heating rates were studied. To this end a chemical shock tube was set up such that reproducible individual shock waves of pre-selectable temperature, pressure and duration could be produced. In addition a parameter study was carried out with the aid of a desk computer system. The gaseous, volatile components were analysed by mass spectroscopy and gas chromatography. The solid residues were subjected to elemental and image analysis. Image analysis of the raster electron microscopic material was only made possible by the most advanced micro-computer technology.

8157 **(NP—5770051) Gasification of different carbon carriers in the fluidized bed.** Licharz, J.R. (Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Bergbau und Huettenwesen). 14 Dec 1982. 158p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number TI85770051.

Different carbon carriers, ranging from anthracitic coals, peat, through to wood were tested with a view to their utilization for fluidized bed gasification. A technical-scale plant was used for the gasification studies to provide the technical reaction data. The objective of this study is to assess the suitability of the various carbon carriers for fluidized bed processing and to discuss the dependence of reactivity of fluidized bed gasification on degree of carbonification.

8158 **(PB—85-106128/XAD) Distillation tower corrosion: synergistic effects of chlorine and phenolic compounds in coal liquids. Final report.** Johnson, T.; Sagues, A.; Davis, B.; Jewitt, C. (Kentucky Univ., Lexington (USA). Inst. for Mining and Minerals Research). Mar 1980. 19p. (IMMR—48-PD23-80). NTIS, PC A02/MF A01.

Prepared in cooperation with Ashland Oil and Refining Co., KY. Sponsored in part by Kentucky Energy Cabinet, Lexington.

Severe corrosion problems were encountered in the fractionator area of major solvent refined coal (SRC) pilot plants. Chemical characterization and corrosion experiments using liquids from the T-105 fractionating tower of the Wilsonville, Alabama SRC plant are described. Tower feed liquids were obtained when the plant was processing low and high chlorine content coals without additives. Liquids from individual trays were obtained when the plant feed included additions of sodium carbonate. Given the plant feed and operational conditions presented, it was demonstrated that the synergistic effect of the ammonium chloride and phenol combination, due in part to ammonium chloride solubility, was likely responsible for the Wilsonville tower corrosion.

8159 **(PB—85-113413/XAD) Model study of combined forced and free convection in underground coal conversion of thin coal seams. Final report June 1982-December 1983.** Riggs, J.B. (West Virginia Univ., Morgantown (USA). Dept. of Chemical Engineering). Apr 1984. 50p. NTIS, PC A03/MF A01.

See also PB84-142611.

An experimental test model, which is dynamically similar to an actual UCC (Underground Coal Conversion) system, has been used to determine fluid flow patterns and local heat transfer that occur in the UCC burn cavity. This study was designed to provide insight into the little understood mechanisms (i.e., heat transfer and oxygen transport to the cavity walls) which control maximum cavity width, and therefore resource recovery during UCC. The dynamically similar flow model has been designed by equating the Grashof and Reynolds number of the UCC system and the flow model, which employs water as its fluid. Equating the Grashof number results in a scale factor of 0.13 while equating the Reynolds number yields a volumetric flow rate of water for the model of 30 gallons per minute. Qualitative studies were conducted with the flow model for both a void cavity and a cavity partially filled with simulated rubble. These studies provided insight into the combined effects of forced and free convection in a UCC cavity. In addition, dimensionless correlations were developed for the heat transfer to side walls for the case of a void cavity and these results can be used to predict oxygen transport to the side wall in a UCC cavity.

8160 **Biotreatment of UCG waste water condensate.** Humenick, M.J.; Brauer, R.; Caire, T.; Lawler, D.F. (Department of Civil Engineering, The University of Wyoming, Laramie, WY). *In Situ;* 8: No. 2, 123-142(1984).

The process of underground coal gasification (UCG) generates a waste water stream during the cooling and processing of the product gas. The waste water stream is of large enough volume and contains a wide array of pollutants, thus posing a significant water pollution problem. The character of UCG condensate is similar to that produced by above-ground gasifiers, although some differences are apparent. The treatment options studied during this laboratory experimental project were activated sludge treatment of raw condensate, activated sludge treatment of stripped condensate, and activated sludge with powdered activated carbon addition for treatment of stripped condensate. The condensates used in the laboratory study were obtained from large-scale field tests in Wyoming. Design and kinetic information for the various activated sludge options are presented, along with detailed performance and kinetic data. Major variables among the treatment options were the amount of dilution water needed to achieve stable operation, the degree of treatment achieved by each option, and the stability of the biological reactor.

8161 **The role of pore structure in coal pyrolysis and gasification.** Simons, G.A. (Physical Sciences Inc., Research Park, Andover, MA). *Progress in Energy and Combustion Science;* 9: No. 4, 269-290(1983).

This article illustrates the importance of the pore structure and transport mechanisms on coal pyrolysis and gasification. It is clear that these processes involve the coupled effects of fluid mechanics and chemistry. Several pore structure and transport models are illuminated.

8162 **Finding order in coal pyrolysis kinetics.** Solomon, P.R.; Hamblen, D.G. (Advanced Fuel Research Inc., East Hartford, CT). *Progress in Energy and Combustion Science;* 9: No. 4, 323-361(1983).

A number of experiments have suggested that the rate constants for the release of tar and for the thermal decomposition of the various functional groups in coal pyrolysis depend on the nature of the bridging bond or of the functional group, but appear relatively insensitive to coal rank for lignites, subbituminous and bituminous coals. The principal variation of pyrolysis behavior with rank is due to variations in the concentrations of functional groups and hence, the amount of each pyrolysis product. If the insensitivity of coal pyrolysis kinetics to coal rank can be generally demonstrated, it represents an important simplifying assumption in any general theory of coal pyrolysis. But the rank insensitivity of rate constants is controversial. There are two major questions. What species exhibit rank insensitive kinetics? Quantitatively, what does insensitivity mean, variations less than factors of two, ten, hundred etc.? This paper considers whether pyrolysis data in the literature support the hypothesis of rank insensitive kinetic rate constants. The experiments considered vary in duration from 1.4 msec to 12 hr and in temperature from 350°c to 1800°c.

8163 **The status of DOE's surface coal gasification projects.** Strickland, L.D.; Fruerman, R. (United States Department of Energy, Morgantown Energy Technology Center, Morgantown, West Virginia 26505). pp 63-83 of Proceedings of the Tenth Annual International Conference on Coal Gasification, Liquefaction and Conversion to Electricity. Pittsburgh, PA, USA; Univ. of Pittsburgh (1983). (CONF-830838—).

From 10. annual international conference on coal gasification, liquefaction and conversion to electricity; Pittsburgh, PA, USA (9 Aug 1983).

The rapidly changing energy picture in the U.S.A., resulting from abundant supplies of lower cost oil and natural gas, has dramatically affected interest in coal gasification. This turnaround in the last two years is reflected in diminished activity in the private sector, including involvement with Synthetic Fuel Corporation and in definite policy shifts in the Department of Energy's Fossil Energy program. An update on current commercial plants, pilot plants, process development units (PDU's), and bench- and laboratory-scale activities is presented herein.

8164 **A process that culls 90% of the minerals and pyritic and organic sulfur from coal.** *Chemical Engineering (New York);* 87: No. 9, 59(5 May 1980).

A process that culls 90% of the minerals and pyritic and organic sulfur from coal and may be useful for the desulfurization of heavy oil prior to hydrocracking is being developed by TRW Systems and Energy Group under a one-year, $307,000 contract obtained recently from the U.S. Department of Energy (DOE). The firm has successfully tested the process on vacuum residua and heavy crude oils. In the process, known as Gravimelt, coal is cleaned by conventional washing and then dried and mixed with powdered potassium hydroxide and sodium hydroxide; upon heating at atmospheric pressure to 375°C, the fused salts react with sulfur in the coal to form metal sulfides. The sulfides may be removed from the melt as calcium sulfide by passing the melt over a bed of lime; the coal floats to the top and is skimmed off. TRW will continue laboratory work under the DOE contract to define the chemistry better and to obtain a materials balance.

0106 Properties

REFER ALSO TO CITATION(S) 0106008111, 8113, 8153, 8195, 8196, 8198, 8199, 8200, 8201, 8206, 8212, 8229, 8230, 8231, 8254, 8279, 8890

8165 **(DOE/ET/11423—T13) Identification and cleavage of breakable single bonds by selective oxidation, reduction and hydrolysis. Quarterly report No. 2, January 1-March 31, 1979.** Buchanan, D.H.; Mayo, F.R. (SRI International, Menlo Park, CA (USA)). 25 Apr 1979. Contract AC22-78ET11423. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003867.

The objective of this project is to determine the structure of bituminous coal with emphasis on the crosslinks and breakable single bonds. During this past quarter, a new gel permeation chromatography system using pyridine as solvent was installed and calibrated. Pyridine dissolved some coal fractions that were only partly soluble in tetrahydrofuran, but the sensitivity of the detector was lower with pyridine because its index of refraction was closer to that of coal products. Acetylation, methylation, trimethylsilylation, and decyldimethylsilylation of the pyridine soluble, toluene-insoluble (asphaltol) fraction of Illinois No. 6 coal extract and of products obtained from that extract were conducted to increase solubilities for NMR studies. This effort was only partially successful, and new NMR data on aromatic and aliphatic hydrogen and carbon contents are presented and conclusions are discussed. Cleavage of the asphaltol fraction was carried out by slow addition of sodium dissolved in ammonia and butylamine. Field ionization mass spectroscopy on the sodium-cleaved asphaltol and its methylation products show that this technique is unsuitable for these coal fractions. A new preparation of black acids from NaOCl oxidation of pyridine-extracted coal contained more aromatic carbon and less aliphatic and carboxyl carbon than a similar product discussed under an earlier contract. Treatment of the asphaltol fraction with bases resulted in 12 to 50% of the asphaltol becoming soluble in ether or alcohol. 10 references, 2 figures, 5 tables.

8166 **(DOE/ET/11423—T14) Identification and cleavage of breakable single bonds by selective oxidation, reduction, and hydrolysis. Quarterly report No. 7, April 1-June 30, 1980.** Pavelka, L.A.; Mayo, F.R. (SRI International, Menlo Park, CA (USA)). 13 Aug 1980. Contract AC22-78ET11423. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003862.

The purpose is to determine the structure of bituminous coal with emphasis on the crosslinks and breakable single bonds. Most of our past cleavage efforts have been directed to the toluene-insoluble, pyridine-soluble (TIPS) fraction of pyridine-extracted coal itself. This report describes extensions of these investigations, as well as experiments with benzylamine extract and with benzylamine extracted coal. Many of our materials are not soluble enough in NMR solvents to give useful ^{13}C NMR spectra, which are needed to follow changes in structure and composition. Efforts to increase the solubility of these fractions continue. Experimental details are presented for the following: (1) investigations of TIPS fraction of pyridine extract of coal; (2) cleavages and alkylations of pyridine-extracted coal; (3) fractionation of benzylamine extract 11-A; (4) oxidations of benzylamine-extracted coal; and (5) extractions of whole coal. 6 references, 1 figure, 3 tables.

8167 **(DOE/ET/11423—T15) Identification and cleavage of breakable single bonds by selective oxidation, reduction, and hydrolysis. Quarterly report No. 11, April 1-June 30, 1981.** Pavelka, L.A.; Zevely, J.; Hirschon, A.; Mayo, F.R. (SRI International, Menlo Park, CA (USA)). 13 Aug 1981. Contract AC22-78ET11423. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003861.

The objective is to determine the structure of bituminous coal with emphasis on the crosslinks and breakable single bonds. This program began with an investigation of the structure of the TIPS fraction of Illinois No. 6 coal, that is, the two-thirds of the 16% extracted by pyridine that is toluene-insoluble, pyridine-soluble, mostly by changes in molecular weight during cleavage reactions in pyridine solution. The most promising of these cleavage reactions were then to be applied to the 84% of coal that is insoluble in pyridine. Near the end of the first year, we found that benzylamine ($BnNH_2$) would extract an additional 14% of material from pyridine-extracted coal. We now report that an EDA-DMSO (ethylenediamine-dimethyl sulfoxide) mixture would dissolve an additional 35% of the original coal. The $BnNH_2$ extract is nearly wholly soluble in pyridine, but the EDA-DMSO extract is only partly soluble in pyridine. Our best present guess is that the $BnNH_2$ extract cleaves most of the ester groups in coal and that EDA-DMSO cleaves the remaining ester and most of the ether groups, thus liberating additional material from the pyridine-insoluble coal network. These two extracts are interesting for structural studies because they were part of the pyridine-insoluble portion of whole coal, instead of being unattached accompanying material. The EDA-DMSO extracted coal is of interest for investigating connecting links because it represents a smaller proportion of the coal network, perhaps containing only hydrocarbon connecting links. Accomplishments for the past quarter are described under the following tasks: extraction of Illinois No. 6 coal; fractionation and saponification with alcoholic KOH; oxidations with NaOCl, O_2, HNO_3 and $AcOH/H_2O_2$; solubility experiments; and fractionation of toluene-soluble fraction. 2 references, 1 figure, 6 tables.

8168 **(DOE/ET/11423—T16) Identification and cleavage of breakable single bonds by selective oxidation, reduction, and hydrolysis. Quarterly report No. 10, January 1-March 31, 1981.** Pavelka, L.A.; Mayo, F.R.; Zevely, J. (SRI International, Menlo Park, CA (USA)). 12 May 1981. Contract AC22-78ET11423. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003860.

The objective is to determine the structure of coal with emphasis on the crosslinks and breakable single bonds. Near the end of the first year, we found that benzylamine ($BnNH_2$) would extract an additional 14% (of the original weight of coal) of material from pyridine-extracted coal. More recently, we found that an EDA-DMSO (ethylene diamine-dimethyl sulfoxide) mixture would dissolve an additional 19% of the original coal. The $BnNH_2$ extract is nearly wholly soluble in pyridine, but the EDA-DMSO extract is

only partly soluble in pyridine. Our best present guess is that the $BnNH_2$ cleaves most of the ester groups in coal and that EDA-DMSO cleaves the remaining ester and most of the ether groups, thus liberating additional material from the pyridine-insoluble coal network. These two extracts are interesting for structural studies because they were part of the pyridine-insoluble portion of whole coal, instead of being unattached accompanying material. The EDA-DMSO-extracted coal is of interest for investigating connecting links, because it represents a smaller proportion of the coal network, perhaps containing only hydrocarbon connecting links. The experimental section of this report describes: solubilities of the EDA-DMSO extracts of Illinois No. 6 coal and the treatment of an extract with sodium; last details (Cl analysis) of an earlier treatment of EDA-DMSO-extracted coal with zinc chloride; oxidations of extracted coals with nitric acid, formic acid + hydrogen peroxide, and oxygen + t-BuOK in pyridine; recent efforts to characterize various oxidation products, mostly black acids; and shows that sulfolane extracted only 0.7% of whole Illinois No. 6 coal. 3 figures, 3 tables.

8169 **(DOE/ET/11423—T17) Identification and cleavage of breakable single bonds by selective oxidation, reduction, and hydrolysis. Quarterly report No. 4, July 1-September 30, 1979.** Pavelka, L.A.; Mayo, F.R. (SRI International, Menlo Park, CA (USA)). 25 Oct 1979. Contract AC22-78ET11423. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003864.

Bituminous coal is assumed to consist mostly of an aggregate of condensed aromatic and aliphatic rings, connected and made insoluble (but swellable) by crosslinks containing only single bonds. The object of this project is to determine the proportions of the various kinds of connecting links and how they can be broken - in other words, to determine the structure of coal, with emphasis on the crosslinks and breakable single bonds. We have made considerable progress in breaking down coal below 100°, mostly with mild reagents. We have increased the solubility of the orginal coal in solvents, compared semiquantitatively the abilities of several agents to cleave asphaltols, probably at ether links, and made large proportions of both extracted coal and asphaltol soluble in weakly basic water solution by oxidation. Oxidations of asphaltol in water suspension with oxygen and NaOCl have been carried out recently, with good conversions and yields of black acids. 4 references, 3 figures, 5 tables.

8170 **(DOE/ET/11423—T18) Identification and cleavage of breakable single bonds by selective oxidation, reduction, and hydrolysis. Quarterly report No. 9, October 1-December 31, 1980.** Pavelka, L.A.; Mayo, F.R.; Zevely, J. (SRI International, Menlo Park, CA (USA)). 24 Mar 1981. Contract AC22-78ET11423. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003865.

Objective is to determine the structure of bituminous coal with emphasis on the crosslinks and breakable single bonds. Some of the highlights of this quarter are: (1) large-scale extraction of benzylamine-extracted coal with ethylene diamine-dimethyl sulfoxide (EDA-DMSO) led to 50.4% recovery of soluble material and 40.5% recovery of undissolved coal; (2) EDA-DMSO extraction appears to have removed essentially all of the ether and ester links in both fractions, leaving only hydrocarbon links; (3) extraction of whole coal by a mixture of N-methylpyrrolidinone (NMP) and EDA is no better than EDA-DMSO, even though NMP alone is a better solvent than DMSO alone; (4) investigators have no evidence that NaOCl will oxidize sulfide links to sulfuric acid and NaOCl appears to be unsuitable for determining sulfide links in coal; (5) black acid fraction from several NaOCl oxidations precipitated between pH 4.98 and 4.66 was characterized; (6) measurements of hydroxyl and carboxyl contents on pyridine and benzylamine extracts and extracted coal show increases in carboxyl content on reactions of these fractions with alcoholic KOH, and an increase in hydroxyl content on reactions of the pyridine-extracted coal with benzylamine, consistent with ester cleavage. 6 tables.

8171 **(DOE/ET/11423—T19) Identification and cleavage of breakable single bonds by selective oxidation, reduction, and hydrolysis. Quarterly report No. 8, July 1-September 30, 1980.** Pavelka, L.A.; Mayo, F.R. (SRI International, Menlo Park, CA (USA)). 31 Oct 1980. Contract AC22-78ET11423. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003863.

The objective of this project is to determine the proportions of the various kinds of connecting links and how they can best be broken - in other words, to determine the structure of bituminous coal. Progress reports are presented for the following: (1) cleavage of pyridine TIPS 28-A with $NaNH_2$; (2) cleavages of pyridine-extracted coal with pyridine hydroiode and alkylation with $NaNH_2$ and BuBr; (3) cleavages and characterization of benzylamine extract 11-A; (4) consumption of KOH by PYR-TIPS 28-A, pyridine-extracted 18-A, $BuNH_2$ TIPS 28-C, and $BuNH_2$-extracted 11-C; (5) extractions of whole coal; (6) oxidation of benzylamine-extracted coal; (7) oxidation of organic sulfides; and (8) fractionation of combined black acids. 4 tables.

8172 **(DOE/ET/11423—T20) Identification and cleavage of breakable single bonds by selective oxidation, reduction, and hydrolysis. Final report.** Mayo, F.R. (SRI International, Menlo Park, CA (USA)). 22 Feb 1983. Contract AC22-78ET11423. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003866.

This final report consists of a summary of our principal accomplishments and conclusions on this contract, and an index to our 16 quarterly reports. The objective of this research was to determine the relative importance of breakable C-O and C-C connecting links between condensed ring systems in Illinois No. 6 coal. Although we have not realized our original goal of quantitative measures of the different proportions of C-C and C-O connecting links in coal, we have shown that our Illinois No. 6 coal contains enough of what we think are -C-O- (ester and ether) links to dissolve 34% of the initial coal that would not dissolve in pyridine and to permit the remainder to swell further in pyridine. We conclude that the proportion of single methylene connecting links is small or unimportant (from low reactivity). We have found that oxygen will supplement oxidation by NaOCl, and we expect that it will supplement oxidation by nitric acid. Essentially all of our reactions have been performed at or below 100°C and at atmospheric pressure. We hope that metal catalysts will improve the selectivity of our oxidations and that our partially degraded coals will be more reactive than ordinary coals in conventional liquefactions. Our work offers a new and promising point of departure for investigation of coal liquefaction under milder than conventional conditions; such work on a new project is now under way.

8173 **(DOE/FC/10614—T14) Fundamental combustion studies of low-rank coal slurries. Quarterly technical progress report No. 3, September 1-November 30, 1984.** Germane, G.J.; Smoot, L.D. (Brigham Young Univ., Provo, UT (USA). Combustion Lab.). 15 Dec 1984. Contract AC18-84FC10614. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003978.

Rheological measurements of the lignite slurry dried at 300°C were conducted for solids loading ranging from 43 to 60% in a capillary viscometer. The slurries generally exhibited shear thinning behavior at high shear rates and Newtonian behavior at lower shear rates. At 60% solids, the slurry was still pourable and appeared to be yield-pseudoplastic, and nearly Newtonian at shear rates of 200 to 500 sec^{-1}. Characterization of physical properties for the subbituminous coal slurries was completed, which showed lower ash and moisture levels than for the lignite slurries. However, opposite to the trend observed for the lignite slurries, the residual moisture in the coal from the subbituminous slurries was higher for the lower process temperature. Installation of the reactor has been nearly completed in the test bay. Investigations of methods to study slurry dispersion, droplet size, droplet/particle velocity and trajectory continued. Apparatus necessary for spray isolation and dispersion measurement has been designed. Demonstration tests with air/water sprays indicate that the spray isolation equipment will be adequate. A review of commercial and laboratory slurry nozzles was completed. Arrangements to receive at least one com-

mercial atomizer were made for possible use, in addition to the slurry nozzle developed at this laboratory, in the spray and combustion tests. 10 references, 7 figures, 2 tables.

8174 **(DOE/FC/10617—1) Thermal dewatering of coal. Progress report, April 1-June 30, 1984.** Suuberg, E.M.; Deevi, S. (Brown Univ., Providence, RI (USA). Div. of Engineering). 1984. Contract AC18-84FC10617. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004119.

According to the management plan for the project, the following items were to have been addressed during the first quarter of the project: coal sample demineralization; porosity determination technique development; sorption technique development; and shrink/swell technique development. All of the above items were addressed with some degree of progress. The demineralization work could not be fully carried out because of the problem in obtaining the final set of coals to be studied. Nevertheless, it was applied to a North Dakota lignite, and resulted in the recommendations as outlined in the section on demineralization. The porosimetry equipment is in place and awaits the arrival of the final sample set. The soprion balance has been suitably repaired and modified to permit controlled atmosphere sorption work. The only additional equipment not yet in place is a constant temperature bath required to maintain a 30°C sample temperature. This is an off-the-shelf item, and will arrive soon. The sorption balance's own furnace turned out to be unsuitable for reliable low-temperature control. The results of the preliminary shrink/swell tests on a North Dakota lignite are reported. These techniques are ready to apply, as soon as the final coal samples arrive. Some work actually performed ahead of program schedule involved the development of reliable oxygen determination techniques. This included setting up the elemental analysis techniques for direct oxygen analysis, and testing the leading candidate techniques or measurement of carboxyl, hydroxyl, and carbonyl groups. 9 references, 1 figure.

8175 **(DOE/PC/40267—1) Combustion characterization of coals for industrial applications. First quarterly progress report, 1 April 1982-30 June 1982.** Borio, R.W.; Goetz, G.J.; Nsakala ya Nsakala; Patel, R.L. (Combustion Engineering, Inc., Windsor, CT (USA)). Aug 1982. Contract AC22-81PC40267. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004226.

Three of the five coals ear-marked for this study have been characterized. These coals include (1) A Montana (Rosebud) subbituminous; (2) An Illinois (No. 6) high volatile bituminous; and (3) A Pennsylvania (Buck Mountain) anthracite. Samples for analyses were prepared in accordance with the ASTM standard (ASTM D 2013-72). The following ASTM analyses were performed on each coal: proximate, ultimate, higher heating value, Hardgrove grindability index, ash fusibility, and ash composition. Additionally, the flammability index (FI) of each coal was determined in an in-house apparatus. The (FI) is indicative of the ignition temperature of a given fuel on a relative basis. These analyses yielded information regarding the ASTM classification of the three coals as well as their chemical, physical, and ignitibility characteristics. 1 figure, 2 tables.

8176 **(DOE/PC/40268—T6) Investigation of pyrite as a contributor to slagging in eastern bituminous coals. Quarterly progress report No. 3, April 1, 1982-June 30, 1982.** (Foster Wheeler Development Corp., Livingston, NJ (USA)). Jul 1982. Contract AC22-81PC40268. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85005226.

The objective of this program is to examine slags formed as a result of firing coals with varying concentration levels, size distribution, and orientation of pyrite with regard to mineral matter in the coal in a laboratory furnace. The program is being executed in the following steps: 1 - selection of eight candidate coals; 2 - chemical characterization of the coal samples and identification of the pyrite size distribution orientation with respect to other mineral matter and concentration levels; 3 - testing of the candidate coals in a laboratory furnace; 4 - chemical and physical characterization of the slag and fly ash samples created by the impurities in the coal sample; 5 - influence of coal benefication on furnace slagging; 6 - analysis of data and identification of parameters influencing the contribution of pyrite to slagging problems. During the second quarter of 1982, coal samples were purchased as part of Task 1. Task 2 characterization of the pyrite size, concentration, and distribution in the coal was begun. Delays in coal shipment resulted in delays in starting Task 2 and Task 3. Combustion testing was begun. 2 figures, 5 tables.

8177 **(DOE/PC/50809—T7) [Determination of the surface reactivity of coal powders]. Second quarterly report, December 1, 1982-February 28, 1983.** Fowkes, F.M. (Lehigh Univ., Bethlehem, PA (USA). Dept. of Chemistry). 13 May 1983. Contract FG22-82PC50809. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004215.

Electrophoresis of coal powders was initiated in Freon 113, then in Freon 113 containing 0.2 to 1% of pyridine to determine coal surface acidity and basicity. Adsorbed pyridine accepts hydrogen ions from surface acids and upon desorption carries positive charges into solution, thus generating negative zeta-potentials on coal particles. No negative potentials developed with low-ash bituminous coal. However with low-ash anthracite (PSOC-870) negative potentials were always observed when pyridine was present. The negative zeta-potentials show that PSOC-870 coal particles have appreciable surface acidity. The positive potentials observed with Freon 113 indicate that surface basic sites have donated electrons to the rather electropositive carbons of Freon.

8178 **(DOE/PETC/TR—85/3) Round robin investigation of organic compounds in aqueous leachates of solid wastes: application to H-coal filter cake leachates.** Avery, M.; Hilpert, L.; Jackson, L.; Junk, G.; Maskarinec, M.; Paule, R.C.; Raphaelian, L.; Richard, J.; White, C.M. (USDOE Pittsburgh Energy Technology Center, PA). 1985. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004009.

The work presented in this report details efforts of six laboratories to develop methods for the analysis of aqueous leachates from fossil fuel solid wastes and to determine their accuracy and precision. Quantitative data on the concentrations of seventeen target organic compounds in aqueous leachates of a fossil fuel waste are presented. Many of the target analytes were selected from Appendices VII and VIII, of the May 19th, 1980, Federal Register. Some organic compounds that are not present in Appendices VII and VIII were also selected because of the probability of their presence in fossil fuel products, by-products, and wastes. These target analytes and four standard compounds that were used as internal standards are the following: Benz[a]anthracene, o-Cresol, Phenanthrene, Carbazole, Naphthalene, 1,4-Naphthoquinone, Phenol, 2-Fluorophenol (standard), n-Octacosane (standard), Azulene (standard), 2,3,4,5-Tetrachlorobiphenyl (standard), n-Tetradecane, 2-Naphthol, n-Hexanoic acid, Dibenzothiophene, Quinoline, Acenaphthylene, 1-Naphthylamine, 2-Picoline, 4-Aminobiphenyl, and Fluoranthene. An analytical method for the determination of organic compounds in aqueous leachates has been developed. This method was evaluated using a series of samples of increasing complexity, starting with simple synthetic aqueous leachates and ending with leachates of fossil fuel wastes. The present report describes the analytical results from four laboratories applying the previously developed analytical method to leachates of an H-Coal filter cake material. These leachates were obtained using both the standard ASTM Method D3987 and the EP leaching procedures. Ten additional compounds of interest were identified in the extract: Indan, Tetralin, 2-Methylnaphthalene, 1-Methylnaphthalene, Tetrahydroacenaphthene, Biphenyl, Acenaphthene, Dibenzofuran, Fluorene, and Diphenyl Ether. 11 references, 2 figures, 16 tables.

8179 **(IS-T—1096) Process-oriented analysis of the behavior of coal minerals at elevated temperatures.** Lindsay, C.G. (Ames Lab., IA (USA)). Dec 1984. Contract W-7405-ENG-82. 183p. NTIS, PC A09/MF A01; GPO Dep. File Number DE85005120.

Thesis.

High-temperature behavior of minerals occurring in coal is of interest because the minerals in coal have been identified as the cause of most of the troublesome aspects of coal utilization. Six minerals, quartz, calcite, pyrite, kaolinite, illite, and montmorillonite, commonly associated with bituminous coals, were selected for analysis under the heating-stage microscope. The minerals were

heated individually (except quartz), in pairs, and in triplets. Two arrangements of triplet assemblages were used; in one, all three species were in mutual contact, and in the other, a clay band separated two non-clay minerals. Quartz was found to be inert in all heating experiments. Calcite and pyrite, after transforming to lime and pyrrhotite respectively, interacted at about 1100°C; oldhamite (CaS) was identified as a product. No other significant mineral-pair interactions were observed. In triplet mounts where pyrite, calcite, and a clay mineral were in mutual contact, interactions between pyrite and calcite were induced at lower temperatures. Supporting experimentation indicated that in these mounts, iron from pyrite migrated into the clay region as the pyrite decomposes. The resulting enhancement in sulfur concentration in the pyrrhotite is considered to be responsible for reduction in the interaction temperature. Studies were made of low-temperature ash suites isolated from coals; some similarities were noted between the thermal behaviors of the ash suites and the laboratory mineral specimens. Comparison with previous studies indicates that the behavior of minerals in their original form is significantly different from the behavior of boiler deposits. 89 references, 16 figures, 7 tables.

8180 **(Juel—1863) Oxidation behaviour of coat-mix-materials in air at temperatures of about 800 K.** Hillen, M.; Luhleich, H.; Nickel, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorwerkstoffe und Heisse Zellen; Technische Hochschule Aachen (Germany, F.R.)). Aug 1983. 174p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE85750070.

Coat-Mix materials were oxidized in a flowing gas mixture of nitrogen and oxygen (N_2/O_2 = 4/1) at about 800 K and under a pressure of 50 kPa. The reaction rate was measured by means of thermal gravimetry and was compared to the changes of specific surface area, porosity, density and compressive strength in dependence on carbon burn-off. The suitability of Coat-Mix materials as a model substance for studying the oxidation behaviour of binder coke and filler separately was proved. The oxidation behaviour of the binder coke was understood only assuming two different components to exist in binder coke. This assumption could be proved by means of a hypothesis on the interaction between the binder and the filler grains during the coking process of the Coat-Mix materials.

8181 (NP—5750388, pp 40-52) **Estimated composition of Danish spray dryer absorber desulphurization end-products.** Winkler, T. Jun 1984. NTIS (US Sales Only), PC A04/MF A01. File Number TI85750388.

In Utilization of waste products from flue gas desulfurization.

The purpose of this report is to publish reliable compositions of FGD SDA (Flue Gas Desulfurization Spray Dryer Absorption) end-products under Danish conditions. The Danish coal is imported from four countries, and the amounts of sulfur, chloride and ash produced from these coals are shown. In the calculation of the composition of the end-product it is estimated that 85% of the ash becomes fly ash. The calculated composition is given of the FGD SDA end-product and the amount of the product produced from 100 kg coal. For each type of coal 3 examples using 3 different ash precollection fractions are shown. The compositions are obtained by stoichiometric calculation.

8182 (UKY-BU—133, pp 53-56) **Assessment of acid loads from various size fractions of sandstone and binder material.** Geidel, G.; Caruccio, F.T.; O'Hagan, M. Dec 1983. University of Kentucky, Lexington, USA. (CONF-831162—).

From National symposium on surface mining, hydrology, sedimentology and reclamation; Lexington, KY, USA (28 Nov 1983).

The effect of various size fractions of two rock types on leachate quality were investigated. Two acid-producing rock types, a sandstone and a binder from an active mine in West Virginia were tested. Approximately 10 tons of each were crushed and screened to five size fractions. Each of the size fractions was loaded into a plastic lined tub connected to collection barrels. Following each significant rain event, the volume of the leachate was measured and a sample collected for analysis (to obtain loads). Samples of rock from each tub were analyzed for pyritic sulfur and alkaline production potential (APP). Within the binder material pyritic sulfur is more concentrated in the finer sized fractions, whilst the APP values for all samples were about the same. Within the sandstones there is a reversal of trends, with lower pyritic sulfur values in the finer factions. Field tests showed that within the sandstones the smallest sizes produce the highest acid loads and that acid generation begins immediately. With increasing size fractions, acid generation slowly increases with time. The binder material, however, responded much differently. The smaller size fraction of the binder produced nearly 10 times the acid load of the larger fractions and all of the larger fractions produced nearly the same acid loads. This also showed the binder material to produce almost four times more acid than equivalent sized sandstones. It was concluded that the permeability and/or the nature of the physical decomposition of the rock controls, to a large extent, the amount of acid produced by a sample. (3 refs.)

8183 **Thermal neutron capture prompt gamma emission spectra of coals.** Herzenberg, C.L. (Argonne National Laboratory, Argonne, Illinois). *Preprint, Society of Mining Engineers of AIME;* **84-121**: 10(Feb 1984). (CONF-840218—).

From 113. annual meeting of the American Institute of Mining, Metallurgical and Petroleum Engineers; Los Angeles, CA, USA (26 Feb 1984).

Recently, neutron-induced gamma spectrometry has been introduced and gained provisional acceptance as a method for continuous automated analysis of coal. Instrumentation based on this technique has been under development for and in testing at coal preparation plants and a coal gasifier. To provide a deeper understanding of, and extended capability in applying this method, theoretical calculations have been performed of the absorption of thermal neutrons by various coal compositions, and the thermal neutron capture prompt gamma emission spectra produced by these compositions have been calculated. Selected results of these computer calculations and the computer generated spectra are presented.

8184 **The thermal and structural properties of the coal in the Big Seam.** Glass, R.E. (In Situ Technologies Division, Sandia National Laboratories, Albuquerque, New Mexico). *In Situ;* **8**: No. 2, 193-205(1984).

In support of the Underground Coal Gasification (UCG) program, Sandia National Laboratories is developing a cavity growth model based on the thermal and structural behavior of the coal. An essential element of this effort is the determination of the thermal and structural properties of coals involved in UCG field tests. One goal of this study is to define a consistent set of thermal and structural properties for the coal in the Big Seam near Centralia, Washington. This goal was accomplished by performing a limited number of properties tests and by correlating the results with properties reported in the literature. These tests included measurement of specific heat, thermal conductivity and thermal expansion. To determine ambient temperature elastic properties, uniaxial compression and indirect tension tests (Brazil), were performed. The results show that the thermal properties are dependent on the water content and that the structural properties are anisotropic and show a high degree of sample-to-sample variability.

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REFER ALSO TO CITATION(S) 0108008178, 8213, 8222, 8225, 8230, 8231, 8232, 8259

8185 **(DOE/CH/00016—2) Systems study for the removal, recovery and disposal of carbon dioxide from fossil fuel power plants in the US.** Steinberg, M.; Cheng, H.C.; Horn, F. (Brookhaven National Lab., Upton, NY (USA)). Dec 1984. Contract AC02-76CH00016. 84p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85004499.

This report examines the feasibility of preventing man-made CO_2 from entering the atmosphere. Utilities produce about 30% of the emissions of CO_2, therefore, the system is first applied in this study to the power plant effluents. An absorption/stripping stack gas scrubbing and regeneration process was chosen for the present system study. An improved solvent process is used and the process is integrated with the power plant operations to improve the efficiency of the combined plant. Three methods of disposal are select-

ed and appropriately applied, depending on geographical proximity to the source power plants. The US Department of Energy Federal Region Divisions for utility power plants was utilized to aggregate and design the disposal system. The energy requirement to drive the various parts of the system is estimated. This is a first order design and cost estimation system study, made primarily for the purpose of determining the order of magnitude feasibility and economic costs for the removal, recovery, and disposal of CO_2 from power plant stacks in the US. The base year chosen for the systems analysis was 1980 and all capacity and costs are indexed to that year.

8186 **(DOE/ET/15492—T50) Laboratory/bench scale testing and evaluation of APT dry plate scrubber. Fiftieth monthly progress report, April 1-30, 1984.** (Air Pollution Technology, Inc., San Diego, CA (USA)). 21 May 1984. Contract AC21-80ET15492. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84011849.

The objective of this project is to conduct a bench-scale experimental evaluation of the dry plate scrubber (DPS) at high temperature and pressure to determine its potential for controlling particulates and alkali vapor emissions from PFBC processes. The technical objective for April was to: continue process design for the PFBC-DPS system; start ash cake prevention experiments; and prepare for presentation at the Fourth Annual Contractor's meeting. Preliminary design calculations were carried out to determine the DPS system size for a 66 MWe combined cycle power plant. The ash cake prevention experiments were not performed because the heat tracing heaters failed. (DMC)

8187 **(DOE/FE/60148—T5) Evaluation of the NOXSO combined NO/sub x//SO_2 flue gas treatment process.** Haslbeck, J.L.; Wang, C.J.; Neal, L.G.; Tseng, H.P.; Tucker, J.D. (NOXSO Corp., Paducah, KY (USA)). Nov 1984. Contract AC22-82FE60148. 205p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE85002617.

This report summarizes the results of an ongoing experimental program at NOXSO's test facility in Paducah, Kentucky. The NOXSO test program has been underway for over two years. The program goals include a study of the process fundamentals to determine the process chemistry, kinetics and the influence of various parameters; studies of the sorbent behavior to determine sorbent properties that contribute to low attrition and efficient sorption; and studies of the process design that determine the physical size and costs of a commercial facility. The report is organized in seven chapters. Chapter 2 is an executive summary of the entire report. Chapter 3 presents current data and our understanding of the sorption process chemistry. Chapter 4 presents a similar description of the regeneration chemistry. Chapter 5 provides data and a model of both sorption and regeneration kinetics. Chapter 6 adds new data on the attrition properties of the NOXSO sorbent. Finally, Chapter 7 presents new design data for the system components and a first presentation of the plant layout for a 125 MWe system module. 38 references, 55 figures, 24 tables.

8188 **(DOE/MC/14617—T1) Denitrification and desulfurization of combustion gases. Quarterly technical progress report No. 7, March 18-June 17, 1982.** Desai, N.J.; Li, H.C.; Yang, R.T. (State Univ. of New York, Buffalo (USA). Dept. of Chemical Engineering). 1982. Contract AC22-80MC14617. 25p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004212.

This program was initially designed for developing new and more efficient processes for the removal of SO_2 and NO/sub x/ from hot combustion gases. For SO_2 removal, the goal was to develop, on a laboratory scale, the Fe_2O_3 catalyzed fluidized bed combustion process. For the NO/sub x/ removal, it was intended to develop a two-step process for NO/sub x/ decomposition to form N_2, with a low-cost sorbent/catalyst and with no NH_3 injection. The study on the iron oxide catalyzed sulfation of limestone has been completed. Based on our kinetic (TGA) data, the Lee-Georgakis model predicts that an 1% Fe_2O_3 coating on Tymochtee dolomite would reduce the lime requirement by about 30 to 40% for 90% sulfur retention for a typical FBC operation. This new process holds considerable economic promises and is ready and recommended for further pilot-scale development. We have had some success with the sodium ferrite sorbent/catalyst in the two-step NO/sub x/ decomposition process. However, Fe_2O_3, which was used as the catalyst for NO decomposition, is not among the best catalysts. Copper oxide is known to be about two orders of magnitude more efficient as Fe_2O_3. And more important, $Cu(SO_4)_2$, which will be formed from CuO in a combustion gas, is as efficient as CuO as a catalyst in NO decomposition. Based on the above reasons, we have been studying CuO containing materials as the sorbent/catalyst. In some of the materials, such as CuO supported in a matrix of a cement and mixed CuO and CaO, have shown that about 40% of the NO originally absorbed can be decomposed into N_2 in the regeneration step. We are now narrowing down the specific CuO containing sorbent which is best in fulfilling all the aforementioned requirements. 8 figures.

8189 **(IS-M—518) Utilization of lime-sinter process residue for the manufacture of a low-alumina portland cement.** Chesley, J.A.; Murtha, M.J.; Burnet, G. (Ames Lab., IA (USA)). 1984. Contract W-7405-ENG-82. 18p. (CONF-8404214—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003078.

From 96. annual meeting of the Iowa Academy of Science; Iowa City, IA, USA (27 Apr 1984).

The lime-sinter process for recovery of alumina from coal conversion solid wastes produces a residue that is largely dicalcium silicate (C_2S) and that contains only 3 to 5% Al_2O_3. Use of this residue will eliminate the need for its disposal and will make the lime-sinter process more attractive financially. The unique composition of the residue makes it an attractive raw material for the manufacture of ASTM Type V (sulfate resistant) portland cement. There is a substantial demand for this type of cement in the western states. The feasibility of thus using the residue is examined and a cost analysis for a combined alumina-portland cement plant capable of using the fly ash from a 1000 MWe coal-fired power station is presented. 12 references, 1 figure, 6 tables.

8190 **(NP—5750388) Utilization of waste products from flue gas desulfurization.** Joens, E. (Niro Atomizer A/S, Soeborg (Denmark)). Jun 1984. 55p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. File Number TI85750388.

The report reviews 20-30 investigations on properties of stabilized desulfurization products. A stabilized end-product is a result of gathering fly ash and desulfurization products in one process. The flue gas desulfurization method is spray absorption. Stabilized end-products from Danish power plants contain 75% fly ash and 25% sulfur binding calcium compounds. Stabilized end-products have better storage properties than fly ash. A large part of the Danish fly ash is used in cement and concrete. Investigations show that concrete properties are improved by using stabilized end-products instead of fly ash. Even if most of the waste products from power plants are used, there still will be a need for storage. The report describes a process for converting stabilized waste products to synthetic gravel. This means that stabilized waste products can be stored in such a way, that it easily can be recovered and used instead of natural gravel.

8191 **(NP—5750391) Desulfurization survey.** (Danish Cooperative Electric Utilities, Copenhagen). Sep 1982. 214p. (In Danish). NTIS (US Sales Only), PC A10/MF A01. File Number TI85750391.

The Danish Cooperative Electric Utilities together with chemical organizations have prepared a survey of desulfurization problems. Acidification and air pollution, international conventions and liabilities, desulfurization technology and economy, waste removal from desulfurization system have been discussed. Coal supplies have to be standardized with regard to sulfur concentration, investments in flue gas desulfurization are expected to be about 1 mld D Kr yearly. Acidification observed in the Swedish lakes is not quite elucidated, but environmental impacts have to be minimized, through coal washing, better combustion and hotter flue gas. Danish coal fueled power plants contribute about 1-3% sulfur precipitation to that in South Scandinavia.

8192 **(PB—84-230432) Enhanced reuse potential of coal slurry transport water: toxic organics assessment and removal. Technical completion report 1 September 1981-31 August 1983.** Sayler, G.S.; Minear, R.A.; Reid, M.C.; Davis, J.W. (Tennessee Univ., Knoxville (USA). Dept. of Microbiology). Sep 1983. 72p. NTIS, PC A04/MF A01.

The qualitative and quantitative occurrence and fate of organic matter leaching into coal slurry transport water was examined for laboratory generated coal slurries and wastewater from the Black Mesa coal slurry pipeline. Factors which may influence both the quantity and composition of organics in the coal slurry transport and its potential for biological treatment were examined with greater emphasis placed on western coals. In addition to qualitative analyses, studies were conducted to determine the mutagenicity of coal slurry wastewater organics and the potential for the formation of carcinogenic, halogenated organic compounds during typical chlorination processes. The results of the investigation demonstrated significant levels of dissolved organic carbon (DOC) in all laboratory formulated slurries; significantly increased by alkaline pH transport conditions and elevated temperatures during coal-water separation. Coal particle dimensions and transport time had little effect on final wastewater DOC. Coal storage may directly increase the DOC of slurry wastewater. The bulk DOC is comprised of polar organic compounds that appear to be derived from humic and fulvic acids, in the range of 1000-10,000 MW with the remainder comprised of low molecular weight (< 1000 MW) aromatic acids. Effective biological treatment of the low molecular weight components of the raw wastewater was demonstrated using activated sludge. The raw wastewater was negative when tested using the Ames Assay for mutagenic agents. However, chlorination of the wastewater was found to result in the production of trihalomethanes.

8193 **(PB—84-246271) High temperature sulfation studies in an isothermal reactor: a comparison of theory and experiment. Report for June 1981-July 1984.** Silcox, G.D.; Slaughter, D.M.; Pershing, D.W. (Utah Univ., Salt Lake City (USA). Dept. of Chemical Engineering). Sep 1984. 25p. NTIS, PC A02/MF A01.

The paper gives high-temperature isothermal data on sulfur dioxide (SO2) capture, obtained as a function of temperature, SO2 partial pressure, and Ca/S molar ratio for a pulverized dolomite (34 micrometer mean size) and a high-purity calcite (11 micrometer mean size). The experimental results indicated that sulfur capture increases approximately linearly with increasing Ca/S ratio and is relatively insensitive to SO2 partial pressure at the conditions tested. Reaction zone temperature was found to critically influence the overall effectiveness of sulfur capture by sorbent injection; as the local temperature increases, the rates of heterogeneous chemical reaction and diffusion increase, but these are ultimately compensated for by a decrease in initial sorbent surface area due to desurfacing during flash calcination. The experimental results were compared with theoretical predictions using a combined diffusion/heterogeneous chemical reaction model which was developed based on a grain formulation. Initial analysis of various fundamental kinetic studies suggested that the intrinsic chemistry was first order in calcium sites and zero order in SO2 partial pressure. Model predictions showed good qualitative and quantitative agreement with experimental data. Analysis of temperature profiles from full-scale utility boilers suggests a strong dependency on quench rate in the sulfation zone.

8194 **(UKY-BU—133) Proceedings, 1983 symposium on surface mining, hydrology, sedimentology, and reclamation.** Graves, D.H. (ed.). (Kentucky Univ., Lexington (USA)). Dec 1983. 566p. (CONF-831162—). University of Kentucky, Lexington, USA.

From National symposium on surface mining, hydrology, sedimentology and reclamation; Lexington, KY, USA (28 Nov 1983).

Papers were presented on the following topics: mining technology; hydrology; sedimentology; reclamation; surface mining technology and policy; poster presentations; phosphate and arid land reclamation; reclamation special applications; and hydrology-sedimentology special applications. 45 papers have been abstracted separately.

8195 (UKY-BU—133, pp 47-51) **Characterization of mine spoil properties as a tool for premining planning.** Phelps, L.B. Dec 1983. University of Kentucky, Lexington, USA. (CONF-831162—).

From National symposium on surface mining, hydrology, sedimentology and reclamation; Lexington, KY, USA (28 Nov 1983).

Current surface mining laws require that toxic material be selectively placed in the reclaimed mine spoil in such a manner as to limit the flow of groundwater flowing through it. In order to understand better the properties of mine spoil and the methods for creating selective placement zones, in-place sampling of several existing mine spoils was made using geophysical density logging. In addition, channel samples were obtained to characterize physical parameters relating to permeability. These were the coefficient of uniformity, coefficient of concavity, void ratio, and effective grain size. In addition, laboratory permeability tests were made on each sample. Triaxial tests were also performed on the various spoils in order to provide information on their shear strength characteristics. Values for the cohesion and angle of internal friction were obtained in this set of tests. Because point load breakage is important in handling mine spoil and in the spoil's final characteristics, uniaxial compressive tests were conducted on the more competent rock types in the overburden. (5 refs.)

8196 (UKY-BU—133, pp 57-66) **Palzo project - water quality trends within a sludge-amended strip mine site.** McGuire, P.E.; Spivey, M.R.; Mason, R.E. Dec 1983. University of Kentucky, Lexington, USA. (CONF-831162—).

From National symposium on surface mining, hydrology, sedimentology and reclamation; Lexington, KY, USA (28 Nov 1983).

The USDA Forest Service acquired a 126 ha unreclaimed tract of strip mine land in 1966. Since acquisition, the site has been managed as a reclamation research and demonstration project within the Shawnee National Forest, Illinois, USA. Establishment of vegetative cover required intensive reclamation measures due to low pH and phytotoxic spoil conditions. During two field seasons beginning in 1975, approximately 216 million litres of municipal sludge from the Chicago Metropolitan Sanitary District were applied at an average rate of 596 dmt/ha over a 26 ha area. Trees and herbaceous cover were successfully established on the amended spoil. Approximately 65 and 14 percent of the west and east subwatersheds respectively were reclaimed. A monitoring program was implemented to evaluate effects on water quality. From 1974 to 1982, stream, subwatershed drainage, and ground water stations were sampled monthly, weekly, and seasonally respectively. The results are presented. (18 refs.)

8197 (UKY-BU—133, pp 67-71) **Need PHC determinations be so complex?.** Betson, R.P.; Poe, M.L. Dec 1983. University of Kentucky, Lexington, USA. (CONF-831162—).

From National symposium on surface mining, hydrology, sedimentology and reclamation; Lexington, KY, USA (28 Nov 1983).

Public Law 95-87 requires that a determination be made of the Probable Hydrologic Consequences (PHC) of proposed surface coal mining on the hydrologic regime, i.e., the quality and quantity of water in surface- and ground-water systems. Both the active- and post-mining consequences should be considered. Design techniques and control technologies such as sediment basins, along with effluent limitations fairly well assure that the active-mining PHC's will be minimal. The post-mining consequences, however, are another matter. Any methods of post-mining PHC's would require consideration of changes to the topography, drainage patterns, soils, overburden rock (spoil) characteristics and land cover. Such modeling becomes complex and expensive, and reasonable values for parameters could probably be selected to show almost any results desired (i.e. degradation, no change, or improvement). It is suggested that potential PHC's can be more cost-effectively handled by describing the setting, the planned reclamation/revegetation measures to be taken, and the expected consequences, than is presently being done with models. A methodology for predicting post-mining water quality is also proposed and the rationale for focusing on potential water quality problems is presented. (6 refs.)

8198 (UKY-BU—133, pp 87-91) **Can sediment ponds meet effluent limitations?.** Poe, M.L.; Betson, R.P.; Singh, R. Dec 1983. University of Kentucky, Lexington, USA. (CONF-831162—).

From National symposium on surface mining, hydrology, sedimentology and reclamation; Lexington, KY, USA (28 Nov 1983).

Water quantity and quality data are being collected at sedimentation basins on six surface mines in the states of Pennsylvania, Maryland, and West Virginia. The sedimentation basins were selected to offer a variety of designs, both in pond configuration, discharge structure(s), and sedimentation enhancing measures. Only basins designed and constructed since the passage of the Surface Mining Control and Reclamation Act were used. The water quality samples are being analyzed for suspended solids, settleable solids, and particle size distribution. (8 refs.)

8199 (UKY-BU—133, pp 121-129) **Suitability of various legume species and varieties for revegetation of acid surface-mined coal spoils of western Kentucky.** Powell, J.L.; Ellis, M.L.; Barnhisel, R.I.; Armstrong, J.R. Dec 1983. University of Kentucky, Lexington, USA. (CONF-831162—).

From National symposium on surface mining, hydrology, sedimentology and reclamation; Lexington, KY, USA (28 Nov 1983).

A legume study was established on acid surface-mined coal spoils in western Kentucky during August of 1977 and April of 1978. Twenty-five entries of selected legume species and varieties of some species were evaluated for yield in small plots on the same growth media, using identical fertility management factors. A split-plot experimental design was used in which there were two main plots, one of which the legumes were seeded alone and the other plots, the legume entries were seeded with 'Ky.31' tall fescue. Two areas were established, one in the fall, the other in the spring. There were three replications of all combinations of main plots and legume entries (split-plots) for each specific seeding season. The legumes evaluated consisted of 3 varieties of birdsfoot trefoil, 7 varieties of alfalfa, 4 varieties of red clover, 4 varieties of sericea lespedeza, 2 varieties of annual lespedeza, and single species entries of alsike clover yellow sweet clover, white clover, hairy vetch, and crpwm vetch. The above listing of species is, in general, the order of their ranking with respect to yield. In addition, spring seedings also out-yielded their counter parts established in the fall. (2 refs.)

8200 (UKY-BU—133, pp 155-161) **Chemical composition of plants and soils from revegetated mine soils.** Keefer, R.F.; Singh, R.N.; Bennett, O.L.; Horvath, D.J. Dec 1983. University of Kentucky, Lexington, USA. (CONF-831162—).

From National symposium on surface mining, hydrology, sedimentology and reclamation; Lexington, KY, USA (28 Nov 1983).

Three abandoned mine soils in the unglaciated Allegheny Plateau (West Virginia) were selected for revegetation experiments on the basis of their chemical and mineralogical properties. Soil samples from all sites were collected and analyzed for pH, plant available nutrients, CEC, clay minerals, total S and toxic elements, such as Al and Mn. On all three sites, the vegetation was sparse in spite of several conventional attempts to revegetate them. These areas had been limed, fertilized, and seeded with no success. Before the present study, the experimental areas were subsoiled and disced. Fly ash, sewage sludge, and chicken mnaure were applied in a factorial combination and disced in thoroughly before planting to the legumes – alfalfa and lespedeza. (12 refs.)

8201 (UKY-BU—133, pp 163-168) **Utilization of minesoils for production of vegetable crops.** Morse, R.; O'Dell, C. Dec 1983. University of Kentucky, Lexington, USA. (CONF-831162—).

From National symposium on surface mining, hydrology, sedimentology and reclamation; Lexington, KY, USA (28 Nov 1983).

Tillable land in mountainous Appalachia is scarce and when available is often shallow and not suited for growth of many crops. Selective overburden placement following stripmining operations provides a viable method of generating a deep soil profile that is suitable for production of vegetable crops. Soil compaction and lack of organic matter, however, seriously impede water infiltration and plant growth in minesoils. The effects of incorporating green-manure crops on soil properties and yield of snap bean and yellow summer squash on minesoils were assessed. Vegetable yields in the green-manure amended plots were equal or greater than national and state averages, throught to be primarily due to improvements in water infiltration into minesoil. In general, nutrient concentrations were within the normal ranges encountered in agricultural soils. Although there were no visual nutrient deficiency or toxicity symptoms, nutrient imbalances possibly accounted in part for differences in crop growth and yield. (23 refs.)

8202 (UKY-BU—133, pp 179-188) **Disposal of excess spoil: durable rock fills.** Robinson, M.K.; Ventura, J.D. Dec 1983. University of Kentucky, Lexington, USA. (CONF-831162—).

From National symposium on surface mining, hydrology, sedimentology and reclamation; Lexington, KY, USA (28 Nov 1983).

Excess spoil disposal practices in surface coal mining prior to the 1977 Surface Mining Control and Reclamation Act (SMCRA) included the end-dumping of overburden material downslope. Regulations subsequent to SMCRA contained excess spoil disposal requirements for placement of spoil in horizontal compacted lifts. The regulations, while prohibiting carte blanche end-dumping, allow selective end-dumping with a method termed durable rock fill construction. This technique is applicable where overburden is predominantly non-friable sandstones, indurated shales, or other rock types which pass slaking indices. The disposal area must be designed in accordance with environmental and geotechnical requirements and may contain no more than 20% of non-durable material by volume. Since the inception of durable rock fill construction, problems related to quality control of rock durability and the percentage of non-durable fill material have developed. These problems are discussed and durable rock fill practices in Appalachia are illustrated. Practical solutions and proposals for future investigations are presented. (12 refs.)

8203 (UKY-BU—133, pp 195-199) **ENCORE soil management model for mine permitting and mine reclamation.** Harner, R.F.; White, M.E.; Welborn, L.E. Dec 1983. University of Kentucky, Lexington, USA. (CONF-831162—).

From National symposium on surface mining, hydrology, sedimentology and reclamation; Lexington, KY, USA (28 Nov 1983).

The ENCORE Soil Management Model is designed to help reclamation scientists and mine operating personnel manage the large amounts of data gathered prior to, during, and after mining; thus allowing for the development and implementation of more efficient reclamation plans. Removal, storage and replacement of the existing soil is emphasized in most state mining regulations and is required by the performance standards of the Office of Surface Mining for coal mines. The Soil Management Model enables mine operators to estimate soil volumes per mine unit and to model soil replacement. Several typical uses for which the soil management model data base and its analysis programs have been designed are discussed. Using the regulations and operator defined minimum topsoil replacement thickness, the system is able to analyze the soil model and mine layout plan to determine cross-hauling, stockpiling, and soil-replacement plans. Data from this modeling effort can be used to define annual acreage of disturbance, reclamation areas, and haulage distances. These data can be used in the development of the mine permit.

8204 (UKY-BU—133, pp 225-232) **Quality of runoff water from soil-covered reclamation sites.** Vipulanandan, C.; Krizek, R.J. Dec 1983. University of Kentucky, Lexington, USA. (CONF-831162—).

From National symposium on surface mining, hydrology, sedimentology and reclamation; Lexington, KY, USA (28 Nov 1983).

Prompted by the need for a greater understanding of problems associated with the reclamation of coal waste piles, a two-year experimental program consisting of monitoring the quality of the run-off water for twenty seven different test plots involving nine different slopes (ranging from about 14% to 33%) for each of three different thicknesses of soil cover (0, 0.15, and 0.30 metres) was undertaken at the Staunton 1 area situated in Macoupin County, Illinois. The primary analysis is directed toward assessing the effect of slope angle and cover thickness on run-off water quality, which is compared with Environmental Protection Agency criteria for public water supplies, fresh water aquatic life, and domestic supplies. Also considered is the time-dependent effect of soil cover on

pH and concentrations of various inorganic nonmetals. An erosion model developed in the earlier study is used to compare the measured and predicted erosion on the slopes. (6 refs.)

8205 (UKY-BU—133, pp 241-245) **Low-cost, low-maintenance treatment system for acid mine drainage using Sphagnum moss and limestone.** Kleinmann, R.L.P.; Tiernan, T.O.; Solch, J.G.; Harris, R.L. Dec 1983. University of Kentucky, Lexington, USA. (CONF-831162—).

From National symposium on surface mining, hydrology, sedimentology and reclamation; Lexington, KY, USA (28 Nov 1983).

Acid seeps which continue after reclamation obligate mine operators to long-term water treatment. To provide a low-cost, low-maintenance alternative to conventional water treatment, the US Bureau of Mines has investigated the feasibility of establishing a Sphagnum moss bog as a self-perpetuating treatment system. The moss removes iron by cation exchange, oxidation of Fe/SUP/2/SUP/+ and precipitation of iron hydroxides and sulfides. Acidity is then neutralized with limestone which, because of the iron removal step, does not become armored. A portable bog/limestone system was constructed, and installed near an acid stream in the Zaleski State Forest, in southeastern Ohio. At an influent flow rate of 16 gallons/hour (1 litre/minute), the small system reduced ferrous iron by as much as 99%, total iron by as much as 72% and acidity (as CaCO/SUB/3) by as much as 90%. The Sphagnum moss tolerated pH as low as 2.3 and, in fact, when acidity fell in the influent water to less than 150 mg/l, acidity reduction by the system decreased. During the 24 hour test period, virtually no armoring of the limestone was observed. (14 refs.)

8206 (UKY-BU—133, pp 255-264) **Factors affecting revegetation of northern Illinois gob piles: a case study at Standard, Illinois.** Iverson, L.R.; Szafoni, D.; Grunwald, C. Dec 1983. University of Kentucky, Lexington, USA. (CONF-831162—).

From National symposium on surface mining, hydrology, sedimentology and reclamation; Lexington, KY, USA (28 Nov 1983).

A typical, barren gob pile in the Longwall District of northern Illinois was studied intensively, to better understand the conditions which plants must accommodate for establishment and survival. Field studies included plant inventories, soil temperature and moisture measurements, and chemical analyses of soils. This research was combined with greenhouse studies designed to elucidate plant-soil nutrient relations, to characterize the critical factors necessary for adequate revegetation. The results suggest that the use of sewage sludge, both for its water-retention and nutritive qualities, should be pursued further for the revegetation of northern Illinois mine gob piles when economically and environmentally acceptable. (27 refs.)

8207 (UKY-BU—133, pp 265-269) **Effect of soil horizon combination on the production of blue grama and western wheatgrass.** Steward, D.G. Dec 1983. University of Kentucky, Lexington, USA. (CONF-831162—).

From National symposium on surface mining, hydrology, sedimentology and reclamation; Lexington, KY, USA (28 Nov 1983).

Regulatory requirements in Wyoming demand preservation of the A, B, and C topsoil horizons during surface mining operations. However, the A, B, and C horizons do not necessarily possess equal ability to support plant growth. These three horizons, as well as unconsolidated overburden (D horizon), were examined for their suitability as plant growth material. Blue grama and western wheatgrass were grown in five horizons or horizon combinations of Decolney, Fort Collins, and Olney soils: A + B, A + B + C, C, C + D, and D. Pots were planted in July 1982, watered three times weekly, and kept under optimum greenhouse conditions. Aboveground biomass was harvested 10 weeks after germination. The results showed that A + B horizon combination was the most productive while the C horizon produced the least. The D horizon was the second poorest plant growth medium. The A + B + C combination was less productive than the A + B, while the C + D combination was slightly more productive than either C or D alone. (4 refs.)

8208 (UKY-BU—133, pp 275-282) **First year effects of rock type and surface treatments on mine soil properties and plant growth.** Daniels, W.L.; Bell, J.C.; Amos, D.F.; McCart, G.D. Dec 1983. University of Kentucky, Lexington, USA. (CONF-831162—).

From National symposium on surface mining, hydrology, sedimentology and reclamation; Lexington, KY, USA (28 Nov 1983).

Natural topsoil in SW Virginia is often thin, rocky, acidic and infertile. As a result, rock spoil topsoil substitutes are commonly used. In order to evaluate the effects of rock type and surface treatments of topsoil, sawdust and sewage sludge on revegetation, a controlled overburden placement experiment was carried out. In the rock mix part of the study, 5 spoil types were evaluated: pure sandstone (SS), pure siltstone (SiS), and mixtures of the two in the ratios of 2:1, 1:1, and 1:2. In the surface treatment part of the study, the effects of adding lime and fertilized topsoil, sawdust, or sewage sludge at various levels were investigated. The plots were carefully constructed to ensure a minimum of four feet of non-compacted mine soil. Rainfall falling on the plots infiltrates completely, while that falling on the surrounding conventional bench areas ponds or runs off. It is suggested that careful overburden selection and placement, coupled with the proper surface treatments, can create a hard rock derived mine soil which is far superior to locally occurring natural soils. (9 refs.)

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 0109008112, 8153, 8182, 8191, 8192, 8194, 8196, 8197, 8198, 8204, 8206, 8227, 8228, 8229, 8230, 8231, 9078, 9081

8209 (ORNL/FETEP—11) **Environmental, health, and safety assessments for direct coal liquefaction. Volume 8c. Characteristics and environmental transport, fate, and effects of solid wastes.** Hunsaker, C.T.; Boegly, W.J. Jr.; Smith, E.D. (Oak Ridge National Lab., TN (USA)). Nov 1984. Contract AC05-84OR21400. 157p. NTIS, PC A08/MF A01; GPO Dep. File Number DE85004775.

This report provides a detailed review of research that has been done to characterize direct coal liquefaction solid wastes and a more general review of relevant research on environmental transport, fate, and effects of these solid wastes and their extracts. The report focuses on information developed for the Solvent Refined Coal (SRC) I and II, H-Coal, and Exxon Donor Solvent (EDS) processes. A wide variety of approaches have been used in characterizing direct coal liquefaction solid wastes. Extraction procedure (EP) tests on large-volume wastes from pilot plants have shown their extracts to be nonhazardous under current Resource Conservation and Recovery Act (RCRA) regulations. Studies on transport, fate, and effects of direct coal liquefaction wastes and their extracts are limited, especially for small-volume waste streams. Future research should include additional investigation of leaching processes, further development of extraction procedures, collection of additional data on the leachability of direct coal liquefaction wastes, and specific studies on transport and environmental effects of actual or representative wastes from all waste streams. For future characterization efforts, greater uniformity in test procedures and a better understanding of the history of waste samples are needed. 143 references, 17 tables.

8210 (ORNL/FETEP—12) **Environmental, health, and safety assessments for direct coal liquefaction. Volume 8d. Environmental transport, fate, and effects of wastewaters.** Millemann, R.E.; Eddlemon, G.K.; Kroodsma, R.L. (Oak Ridge National Lab., TN (USA)). Nov 1984. Contract AC05-84OR21400. 80p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85004774.

Direct coal liquefaction is a developing technology for which detailed environmental studies are few and more complete information is needed for compliance with Federal Acts. This paper is a critical review of the literature on environmental transport, fate, and effects of direct coal liquefaction wastewaters including cooling tower drift with emphasis on the SRC I and II, H-Coal, and Exxon Donor Solvent processes. It was done to assess the status of research that has been accomplished and to serve as a basis for planning future research programs. The review is orga-

nized around the following topics: (1) the initial issues that were believed to be important for the assessment of the transport, fate, and effects of direct coal liquefaction wastewaters; (2) the research done to address these issues; (3) the initial issues that were resolved by this research; and (4) additional or new research needs. 70 references, 7 figures, 15 tables.

8211 **(ORNL/TM—9120) Environmental risk analysis for indirect coal liquefaction.** Barnthouse, L.W.; Suter, G.W. II; Baes, C.F. III; Bartell, S.M.; Cavendish, M.G.; Gardner, R.H.; O'Neill, R.V.; Rosen, A.E. (Oak Ridge National Lab., TN (USA)). Jan 1985. Contract AC05-84OR21400. 134p. NTIS, PC A07/MF A01; GPO Dep. File Number DE85004767.

Environmental Sciences Division Publication No. 2309.

This report presents an analysis of the risks to fish, water quality (due to noxious algal blooms), crops, forests, and wildlife of two technologies for the indirect liquefaction of coal: Lurgi and Koppers-Totzek gasification of coal for Fischer-Tropsch synthesis. A variety of analytical techniques were used to make maximum use of the available data to consider effects of effluents on different levels of ecological organization. The most significant toxicants to fish were found to be ammonia, cadmium, and acid gases. An analysis of whole-effluent toxicity indicated that the Lurgi effluent is more acutely toxic than the Koppers-Totzek effluent. Six effluent components appear to pose a potential threat of blue-green algal blooms, primarily because of their effects on higher trophic levels. The most important atmospheric emissions with respect to crops, forests, and wildlife were found to be the conventional combustion products SO_2 and NO_2. Of the materials deposited on the soil, arsenic, cadmium, and nickel appear of greatest concern for phytotoxicity. 147 references, 5 figures, 41 tables.

8212 **(STF—15A82038) Environmental measurements of coal heated boilers - underfeedstokers.** Hustad, J.E. (Selskapet for Industriell og Teknisk Forskning, Trondheim (Norway). Div. of Structural Engineering). Dec 1982. 38p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. File Number TI85750430.

Emission measurements of dust and sulfur dioxide (SO_2) from three coal heated boilers in Lier are carried out. The amount of dust from two of these boilers was between 57-115 mg/Nm^3. The Statens Forurensningstilsyn ((SFT) National pollution control board) requires a maximum effluent level of 300 mg/Nm^3 and the SFT required as a maximum 175 mg/Nm^3. The boilers were heated with coal containing 1.07% sulfur. The SFT requires 1.2% sulfur as a maximum in the coal used for these boilers. The SO_2 emission was thence lower than the SFT requirements. 4 drawings, 18 tables.

8213 **(UKY-BU—119) Proceedings, symposium on surface mining, hydrology, sedimentology, and reclamation.** Carpenter, S.B. (ed.). (Kentucky Univ., Lexington (USA)). Dec 1979. 362p. (CONF-791262—). University of Kentucky, Lexington, USA.

From Symposium on surface mining hydrology, sedimentology and reclamation; Lexington, KY, USA (4 Dec 1979).

Three principal areas are examined: reclamation, hydrology, and sedimentology. Reclamation is sub-divided further: soil amending mulches and moisture relationships are considered; planning, prime farmland, and economics; revegetation of surface mine spoil by use of various plant species; and lastly, top soiling and overburden management. Hydrology is investigated in terms of acid mine drainage, drainage runoff, hydrologic impacts of surface mining of coal, and groundwater monitoring and control. Sections on sedimentology evaluate predictive techniques for sediment control including the sculpturing of reclaimed land to decrease erosion; and chemical treatments for removal of manganese and suspended soils. Water quality assessment is an area where hydrology and sedimentology overlap and is considered in terms of assessment models, water quality degradation and hydraulics.

8214 (UKY-BU—133, pp 207-216) **Approaches for conducting cumulative hydrologic impact assessment for surface coal mining operations.** Nadolski, J.A.; Pike, T.J.; Frickel, D.G. Dec 1983. University of Kentucky, Lexington, USA. (CONF-831162—).

From National symposium on surface mining, hydrology, sedimentology and reclamation; Lexington, KY, USA (28 Nov 1983).

Cumulative hydrologic impact assessment (CHIAs) of surface mining are reviewed in order to determine the methodologies and approaches usedin the studies and to recommend a general approach to preparing a CHIA. Definitions, data sources and methodologies pertinent to this process are discussed, and legal and regulatory requirements placed on the regulatory authority are considered.

8215 (UKY-BU—133, pp 217-224) **Case study of the probable hydrologic consequences of surface mining in Buchanan County, Virginia.** Cheng, M.S.; Ridgway, J.W. Dec 1983. University of Kentucky, Lexington, USA. (CONF-831162—).

From National symposium on surface mining, hydrology, sedimentology and reclamation; Lexington, KY, USA (28 Nov 1983).

The Virginia Coal Surface Mining Reclamation Regulations require that an assessment of the probable hydrologic consequences of the proposed coal mining activity be provided by each permit applicant. A simplified approach of predicting the changes which might occur at a surface mining site are presented and the way in which these changes affect the hydrologic cycle of the surrounding area is considered. Evapotranspiration was estimated by the Thornthwaite Method, stream flow variation was shown by daily duration curves using linear regression analysis between a gaging station and the study area, and sediment yields were calculated by the Universal Soil Loss Equation and the Delivery Ratio Method. The time distribution of water qualities for both groundwater and surface water in the premining condition was predicted by the statistical analysis between water quality and flow rate using the sampling data taken at the study area. Finally, the prediction of the postmining impact on water qualities of surface water and groundwater was performed by a statistical analysis using the sampling data collected. (28 refs.)

8216 (UKY-BU—133, pp 233-236) **Relation of surface runoff quality to precipitation quality on a surface coal mine.** Boyer, D.G. Dec 1983. University of Kentucky, Lexington, USA. (CONF-831162—).

From National symposium on surface mining, hydrology, sedimentology and reclamation; Lexington, KY, USA (28 Nov 1983).

Precipitation and runoff samples from 25 storm events in 1981 and 1982 were collected from a reclaimed mountain top removal coal mine in Raleigh County, West Virginia. Watersheds of 2.5 ha and 7 ha contained two precipitation collectors each, were gauged by 0.9 m H-flumes with Coshocton-type runoff samplers, and drained into sediment ponds. Precipitation, runoff, and pond inlet and outlet samples were analyzed for pH and strong acidity. The samples were then frozen and later analyzed for SO/SUB/4 concentrations. There was no evidence indicating that the study mine, which underwent acceptable reclamation practices, had a problem meeting water quality criteria because of acidic precipitation. (5 refs.)

8217 (UKY-BU—133, pp 237-240) **Leach column study to predict reconstructed aquifer water quality.** Stowe, R.R. Dec 1983. University of Kentucky, Lexington, USA. (CONF-831162—).

From National symposium on surface mining, hydrology, sedimentology and reclamation; Lexington, KY, USA (28 Nov 1983).

Leach columns were set up in May 1982 to help predict the water quality in reconstructed creek alluvium and sand paleochannel aquifers at the Belle Ayr mine, Wyoming, USA. Leach columns were constructed from 5-inch PVC pipe; sand and water were added from the top, and the leachate drawn off from the bottom. Three sets of 3 leach columns per set were filled with sand from the same source, but differing types of water were used. Alluvial water, from a dewatering pit dug in alluvium, was leached through one set of columns; water from a sand paleochannel well was leached through 3 others; distilled water acted as a control group in the final 3 columns. Water was drawn from the columns at 4 different times so that 2 pore-volumes of water moved through the sand. The final draw occurred in July of 1982. The water quality of the column leachates was assessed by an analysis of various param-

eters, including pH, alkalinity, conductivity, hardness, total dissolved solids, and cation and anion concentrations.

8218 (UKY-BU—133, pp 247-254) **Underground mine reclamation via blasting.** Royse, K.W. Dec 1983. University of Kentucky, Lexington, USA. (CONF-831162—).

From National symposium on surface mining, hydrology, sedimentology and reclamation; Lexington, KY, USA (28 Nov 1983).

Within the State of North Dakota there are 87 abandoned mine land sites which have been classified as constituting health, safety, or general welfare problems. Two options for reclaiming the underground mine sites are total excavation and backfilling, or remote backfilling. A third option, previously virtually untried, involves the use of explosives to initiate and complete collapse of abandoned underground workings. A test project is described which aimed to determine whether blasting is an efficient and cost effective method of reclamation. The results of the blasting tests indicate that this method is feasible, given conditions similar to the site used for the tests, although it is not a technique which has blanket application.

0110 Reserves And Exploration

8219 (PB—85-107951/XAD) **Western Kentucky coal resources.** Smith, G.E.; Brant, R.A. (Kentucky Univ., Lexington (USA). Inst. for Mining and Minerals Research). Sep 1978. 169p. (IMMR—47-RRR8-80). NTIS, PC A08/MF A01.

Prepared in cooperation with Kentucky Geological Survey, Lexington. Sponsored in part by Kentucky Energy Cabinet, Lexington.

The Western Kentucky coal field originally contained 40,989,293,000 short tons of coal; remaining coal is estimated to be 38,626,562,000 short tons. Several coal beds account for more than 93% of the estimated coal. Twenty-five percent of the total is contained in the No. 9 (Mulford) coal bed. The No. 11 (Herrin) and No. 12 (Paradise) coal resource estimates are combined and their original total is 9,620,362,000 short tons. Other coal beds include the No. 6 (Davis) with 7,482,922,000 tons and the No. 4 (Mannington) with 6,585,894,000 tons and the No. 13 (Baker) with 3,206,648,000 short tons. The remaining 26 coal beds are of small extent and represent 7% of the original resource or 2,547,774,000 short tons.

8220 **Production potential for coalbed methane in US basins.** Byrer, C.W.; Covatch, G.L.; Morz, T.H. (Dept. of Energy). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE/DOE/GRI 12832**: 15-28(May 1984). (CONF-8405120—).

From SPE/DOE/GRI unconventional gas recovery symposium; Pittsburgh, PA, USA (13 May 1984).

The U.S. Department of Energy (DOE) has promoted widespread commercial use of coalbed methane through the Coalbed Methane Project. To date, the major emphasis has been directed toward locating and estimating the magnitude of the resource, estimating the recoverable reserves, developing economical recovery systems and techniques, and demonstrating utilization in an appropriate manner. Preliminary results of the coalbed methane resource effort show that many of the coal regions in the United States have significant volumes of coalbed methane. The initial methane resource estimates for 16 basins show that the greatest potential is in the Piceance, Northern Appalachian, Central Appalachian, Powder River, and Greater Green River. Small, high potential target areas have been selected for an in-depth analysis of the resource. At the present time, industry is showing the greatest interest and activity in the Warrior, San Juan, Piceance, and Northern Appalachian Basins. The relationship between industry activity and the high potential target areas in four of the coal basins is presented in this report. Production curves for several coalbed methane wells in these basins are presented for comparison. The number of minable seams, coal reserves, coal rank, depth and methane gas content are the parameters listed for each of these four basins. Recommendations are also suggested for developing the coalbed methane resource in the remaining basins.

0120 Mining

REFER ALSO TO CITATION(S) 0120008182, 8194, 8195, 8196, 8197, 8198, 8199, 8200, 8201, 8202, 8203, 8204, 8205, 8206, 8207, 8208, 8213, 8214, 8215, 8216, 8217, 8218, 8259, 8335, 8336, 8337, 8338, 8339, 8340, 8341, 8348

8221 (PB—84-244359) **Airblast and ground vibration generation and propagation from contour mine blasting. Report of investigations/1984.** Stachura, V.J.; Siskind, D.E.; Kopp, J.W. (Bureau of Mines, Twin Cities, MN (USA). Twin Cities Research Center). 1984. 38p. (BM-RI—8892). NTIS, PC A03/MF A01.

Library of Congress catalog card No. 84-600051.

The Bureau of Mines studied airblast and ground vibrations produced by surface coal mine blasting in Appalachia to determine the topographic or other region-specific effects on generation and propagation. Arrays of seismographs were used to measure blast effects in both rolling-terrain and steep-slope contour coal mining areas. Comparisons were then made with previous blasting data from studies of midwest coal mines located in flat areas.

8222 (UKY-BU—133, pp 1-3) **Experimental practices opportunities under the Federal Surface Mining Control and Reclamation Act of 1977.** Cooper, B.V. Dec 1983. University of Kentucky, Lexington, USA. (CONF-831162—).

From National symposium on surface mining, hydrology, sedimentology and reclamation; Lexington, KY, USA (28 Nov 1983).

The passage in 1977 of Public Law 95-87 brought a new era of federal environmental and administrative controls to the American coal industry. Numerous difficult and expensive 'environmental protection performance standards' must now be met by coal operators, and implementing regulations issued by the federal Office of Surface Mining assure stringent enforcement. Unknown to most coal operators is the fact that considerable relief is available under the 'experimental practices' provisions of the law. Section 711 outlines procedures which can be used by operators to depart from any of the environmental protection performance standards of Section 515 (surface mines) and/or Section 516 (surface effects of underground mines). Surprisingly, these procedures are often relatively easy to use - and operators could experience both increased coal recovery and sizeable direct savings in mining and reclamation costs. Valuable insight is provided into the entire concept of 'experimental practices.', not only for coal operators, but for regulatory authority personnel, consultants, and others who are involved in coal mining.

8223 (UKY-BU—133, pp 5-12) **Operator response to work intensity of front-end loaders.** Adler, L.; Lotfi, M. Dec 1983. University of Kentucky, Lexington, USA. (CONF-831162—).

From National symposium on surface mining, hydrology, sedimentology and reclamation; Lexington, KY, USA (28 Nov 1983).

Front-end loaders are important to the construction and mining industries, and also responsible for a high proportion of accidents. The mental stress on the equipment operator can radically influence both productivity and safety. This stress was simulated for the first time by use of the workload intensity concept from human factors engineering. A curve was constructed for a typical cycle composed of operator tasks and environmental stressors against time. The major variables being considered are: 1) equipment characteristics, 2) working conditions, and 3) operating activities. A standard wheel loader was studied, operating under good conditions and executing a fairly normal operating pattern. Potential methods for measuring operator stress include: physiological, performance, and subjective (questionnaire) techniques. Due to the preliminary nature of the study only the latter was employed. Operator responses to questionnaires were compared to the workload curve. The correlations proved encouraging, with discrepancies being carefully noted. On the basis of favorable results, specific recommendations were made for improving the working conditions, operational activities and the equipment characteristics. (9 refs.)

8224 (UKY-BU—133, pp 13-15) **New drilling greases that will not contaminate overburden samples.** Dollhopf, D.J.; Goering, J.D. Dec 1983. University of Kentucky, Lexington, USA. (CONF-831162—).

From National symposium on surface mining, hydrology, sedimentology and reclamation; Lexington, KY, USA (28 Nov 1983).

During pre-mine environmental studies in western states, overburden samples collected from drill holes are chemically analyzed for numerous metals to identify geologic zones that may be unsuitable for root zone and aquifer reestablishment. Specialized greases high in metal content are used on drill pipe sections and occasionally mix with overburden samples causing chemical contamination. At least 90% of the commercially available drilling greases have a high potential to contaminate overburden samples and are not recommended for use. Two drilling greases developed in this study will not contaminate overburden samples, have excellent physical performance regarding make-up and break-out torques, and are highly recommended. Several other drilling greases available commercially are considered acceptable, meaning they will not contaminate samples but have relatively poor physical performance suggesting high breakout torques. (3 refs.)

8225 (UKY-BU—133, pp 17-21) **Stackers - the friendly giants in reclamation.** Britton, R.R.; Gozon, J.S.; Konya, C.J. Dec 1983. University of Kentucky, Lexington, USA. (CONF-831162—).

From National symposium on surface mining, hydrology, sedimentology and reclamation; Lexington, KY, USA (28 Nov 1983).

Bucket wheel excavator systems in which excavated material is transported continuously are used extensively overseas, but they have been applied to a limited extent in the United States. The major components of such a system are: bucket wheel excavator, mobile bridge conveyor, hopper car riding on belt structure, around-the-end or cross-pit conveyors, tripper car and stacker (spreader). A mobile stacker takes the overburden material from the tripper car and discharges it directly to spoil in the mined-out area so the subsequent leveling required for reclamation can be minimized. Some aspects of the uses and limitations in the application of stackers in mined land reclamation are discussed. In particular, attention is given to the equipment selection considerations and the interdependence of machine size and cost. (4 refs.)

8226 (UKY-BU—133, pp 23-31) **Structural design considerations for a mining dragline boom system.** Watwood, V.B. Dec 1983. University of Kentucky, Lexington, USA. (CONF-831162—).

From National symposium on surface mining, hydrology, sedimentology and reclamation; Lexington, KY, USA (28 Nov 1983).

The fundamental roles of each component of the dragline boom system are reviewed along with a consideration of the source of loading on these components. The most complex and difficult to understand components are the intermediate boom suspension cables. Emphasis is placed on their role and behaviour. Certain very important parameters of the boom design are established by operational requirements in the pit. However, there are several other design parameters that can be adjusted to provide for minimum first cost or optimum service life. The tradeoffs involved with these parameters are discussed and the results of some parameter variation studies are given. One of the most significant parameters which emerges from these studies is the angle between the boom centerline and the main upper suspension. The optimum value for this angle depends on many factors but for typical designs it appears to be about 20 to 22 degrees. (1 ref.)

8227 (UKY-BU—133, pp 33-40) **Determination of the impact of surface mining on air quality using the Valley air quality simulation model.** Valiknac, T.J.; Greenberg, M.A.; Abernathy, M. Dec 1983. University of Kentucky, Lexington, USA. (CONF-831162—).

From National symposium on surface mining, hydrology, sedimentology and reclamation; Lexington, KY, USA (28 Nov 1983).

Valley, a steady-state, Gaussian plume dispersion model, was used to determine projected 24-hour and annual ground level concentrations of total suspended particulate matter in the vicinity of a proposed mine in Washington state. Key input parameters are meteorological data (stability-wind summary) and source emission rates. Using the mining and reclamation plan, the extent of each mining related activity is determined. Applying the appropriate emission factors, total mining related emissions are estimated on a year-by-year basis and for critical mining periods. These individual contributions are input as appropriate point and/or area sources, together with other parameters, such as source coordinates and ground elevations, effective height of emissions, source environment, map scaling factor and receptor elevations, etc. Using values of input parameters which best represent actual conditions, the computer model may be used to project compliance with state or local air standards, target processes or activities which may require mitigative measures and divert possible citizen complaints. (11 refs.)

8228 (UKY-BU—133, pp 41-46) **Stream channel reconstruction: the problem of designing lower order streams.** Tarquin, P.A.; Baeder, L.D. Dec 1983. University of Kentucky, Lexington, USA. (CONF-831162—).

From National symposium on surface mining, hydrology, sedimentology and reclamation; Lexington, KY, USA (28 Nov 1983).

The design and reconstruction of lower (first and second) order stream channels presents a unique problem since these channels comprise the majority of the total stream length on premining surfaces and usually occur on the steepest slopes. The regime approach is discussed with specific reference to the design of lower order drainage basins. Data collected from premining lower order basins serves as the basis for the design of reconstructed streams. Case studies of two reclaimed first order basins identified several critical factors important to the reclamation of stable stream channels. A procedure for designing lower order basins and channels is presented. (12 refs.)

8229 (UKY-BU—133, pp 73-79) **Changes in ground water quality associated with cast overburden material in southwest Perry County, Illinois.** Oertel, A.O.; Hood, W.C. Dec 1983. University of Kentucky, Lexington, USA. (CONF-831162—).

From National symposium on surface mining, hydrology, sedimentology and reclamation; Lexington, KY, USA (28 Nov 1983).

A study was conducted in southwest Perry County, Illinois to assess the changes in ground water brought about by surface coal mining. Four large surface mines in and near the study area have mined over 15,300 acres for the Herrin No.6 and Harrisburg No. 5 Coals since 1962. Approximately 15,000 additional acres in the vicinity are proposed to be permitted under Illinois' permanent regulatory program. Twenty-six water observation wells were used in the study. Discharges from the toe of cast overburden in an active pit were also collected. Measurements were made of hydraulic conductivity, electrical conductivity, total dissolved solids, and ion levels (notably calcium, sodium, carbonates and sulfates) of the overburden and interburden waters. (16 refs.)

8230 (UKY-BU—133, pp 93-99) **Sediment yield and surface runoff water quality from a steep-slope, back-to-contour surface mining spoil in the New River Basin of Tennessee.** Dickens, P.S.; Tschantz, B.A.; Minear, R.A. Dec 1983. University of Kentucky, Lexington, USA. (CONF-831162—).

From National symposium on surface mining, hydrology, sedimentology and reclamation; Lexington, KY, USA (28 Nov 1983).

Sediment yield and surface water quality from a steep-slope, back-to-contour, coal surface mining spoil in the New River Basin of Tennessee were monitored for a period of three years between 1978 and 1981. Sets of instantaneous samples for suspended solids, iron, manganese, calcium and magnesium were obtained from a total of 21 storm events. Sediment bedload was also measured. The spoil runoff studied is non-acid. The sediment and runoff quality data are presented, in particular their response with elapsed time since the completion of mining. Sediment bedload and particle size data are also given. These results are compared with Federal mine effluent water quality standards and with premining, or undisturbed, storm water quality in the study area. (8 refs.)

8231 (UKY-BU—133, pp 107-111) **Simulation studies on rates of pyrite oxidation in coal mine sediment ponds.** Evangelou, V.P.; Grove, J.H.; Rawlings, F.D. Dec 1983. University of Kentucky, Lexington, USA. (CONF-831162—).

From National symposium on surface mining, hydrology, sedimentology and reclamation; Lexington, KY, USA (28 Nov 1983).

Sediment ponds in disturbed lands are used as water treatment basins. The Reclamation Act of 1977 states that water released from disturbed lands should be of quality equal to or better than pre-mining conditions. In pyritic spoils, sediment ponds act as sediment traps. Pyritic sediments introduced into ponds continue to oxidize and water quality is adversely affected. An experiment was carried out to determine the following parameters: The size of particles that acidity resides on, the effects of liming rates on sulfate generation, and the role of bacteria in mediating oxidation processes in pyritic suspensions. The data strongly support the theory that effective control of acid generated by pyritic suspensions can be introduced by building control structures in a series. Furthermore, the data point out that excess lime addition initially has an inhibitory effect on salt generation, but that later on such ponds generate as much or more sulfate salt as unlimed catchments. (11 refs.)

8232 (UKY-BU—133, pp 131-139) **Potential hazards and benefits of highwalls.** Perkins, M.P.; Klimstra, W.D.; Nawrot, J.R. Dec 1983. University of Kentucky, Lexington, USA. (CONF-831162—).

From National symposium on surface mining, hydrology, sedimentology and reclamation; Lexington, KY, USA (28 Nov 1983).

A study to identify potential hazards and benefits associated with highwalls resulting from surface mining was conducted during 1979 and 1980 at 110 sites selected in 11 Illinois counties. These reflected 50 km (8%) of approximately 589 km of highwalls known to exist in 42 countries where surface mining has occurred. Data examined were overburden depth, thickness of coal seam, height of wall above water, angle of repose, percentage of vegetative cover, condition of highwall (eroding, sloughing, stable), approximate year mined, mining method, area utilization, protective measures, and proximity to areas of human activity. Factors contributing to highwall stability were examined and the most influential identified and included in a stability index. A degree hazard ranking was developed emphasizing stability, proximity/access, protection, and physical characteristics (height, slope angle). Approximately 40 sites (36%) were judged moderate to severe hazards; a majority (64%) reflected minimal or low hazards. Most associated water impoundments were valuable resources for wildlife, recreation, agriculture, municipal, and livestock needs. (69 refs.)

8233 **Management practices--production analysis and improvement.** Minnucci, C.A.; Hernai, A.S. (Science Applications, Inc., Wayne, Pennsylvania). *Preprint, Society of Mining Engineers of AIME;* **84-14**: 8(Feb 1984). (CONF-840218—).

From 113. annual meeting of the American Institute of Mining, Metallurgical and Petroleum Engineers; Los Angeles, CA, USA (26 Feb 1984).

In 1978, the U.S. Department of Energy funded a 2-year study to identify and quantify causes of the post-1969 coal mine productivity decline. A large number of factors hypothesized to have affected productivity during this period were analyzed using regression techniques. The results were particularly interesting for two of the factors--mining method and shift scheduling. The study results indicate that the use of longwall mining has an insignificant impact on overall mine productivity, compared to other methods, and mines operating on a two-production shift per day schedule are more productive than mines employing other shift schedules.

8234 **(HSE-Trans—10005) Experimental study of the electrostatic hazards associated with the use of non-conductive tubes in a firedamp atmosphere.** Movilliat, P.; Dangreaux, J. (Health and Safety Executive, London (UK)). 1981. Translation source information not available . (CONF-8110246—2). 15p. NTIS (US Sales Only), PC A02. File Number DE85900533.

From 19. international conference of research institutes in safety in mines; Katowice, Poland (5 Oct 1981).

Certain pieces of equipment used underground in French coal mines have for a long time been subjected to specifications with the view to preventing electrostatic hazards associated with their use. Particular attention has always been paid to compressed-air tubes, while for water and hydraulic transmission hoses, it was not deemed necessary to enforce specifications. This situation was provisional however, and it has been thought advisable to make a study to see whether rubber and plastic hoses are liable to produce dangerous electrostatic discharges in a firedamp atmosphere when water or hydraulic fluids flow through them or when hoses are being installed. It was found that the flow of water or of a 3% oil in water emulsion (aerated or not), at high velocities up to 10 m/s, under a pressure up to 18 bars, does not produce detectable charges in the liquid or on the surface of the tube; and that charges which might be produced when fluids are flowing through flexible hydraulic hoses are not associated with new hazards. In consequence, for studying the risks associated with the installation and the use of water and hydraulic hoses in a firedamp atmosphere, it is possible to consider only empty hoses or hoses filled with non-flowing conductive fluids. By artificially charging the external surface of a hose either by rubbing or corona discharge, we have examined whether dangerous sparks could occur between the hose and earth. It was found that testing is not necessary for water and hydraulic transmission hoses with an external diameter up to 20 mm or with an electric resistance up to 10^{10} ohms (measured under 500 volts between an internal end-electrode and a surface electrode 1 meter apart, after 24-h conditioning at 23°C and 50% relative humidity. 7 references.

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8235 **(DTH-LET-RE—84-8) Simulation model of coal combustion system.** Mosbech, H. (Danmarks Tekniske Hojskole, Lyngby. Lab. for Energiteknik). Apr 1984. 111p. (In Danish). NTIS (US Sales Only), PC A06/MF A01. File Number TI85750427.

A dynamic mathematical model has been made and programmed that describes the most important processes of a coal mill, coal powder pipe, and combustion chamber. The mill model is based on energy balance, mass balances for coal, water and air, and on descriptions of the milling, the sieving, and the drying processes. In the pipe model the calculated quantities are transferred to the combustion chamber with a time delay. In the combustion chamber model the air excess, temperature, irradiation intensity, not-combusted coal in the ash, and oxygen and carbon dioxide content of the smoke are described. To support the model development and to control the finished model, measurements have been made on a power plant under non-stationary operation. The comparison between the measurements and calculations shows that the outlet temperature and the coal powder production of the mill are calculated correctly in the model. The characteristic of the system is dominated by the dynamic qualities of the mill. The dynamic qualities are determined by the crushing speed which depends on the milling fitness of the coal, the mill type, and on the condition of the mill. Also the adjustment of the sieve affects the dynamic qualities. The relation between mill, pipe, and combustion chamber is illustrated by simulating a load change.

8236 **(ICTIS/M—0169) Blending and homogenising.** (Coal Research Association of New Zealand, Wellington). May 1984. 10p. Coal Research Association of New Zealand, Wellington.

Recent overseas developments in blending/homogenising systems, and their potential application in New Zealand, are described. The relatively-small scale of operation is likely to limit the New Zealand use of technology which is applied overseas, and two ideas for modifications which could reduce the capital cost of small units, are presented. (Available from IEA Coal Research, quote ICTIS/M0169)

8237 **(ICTIS/M—0170) Steam-heated screw dryer for removal of surface moisture from industrial small coal.** (Coal Research Association of New Zealand, Wellington). Jun 1984. 12p. Coal Research Association of New Zealand, Wellington.

The problems arising from the presence of excessive surface moisture on industrial coal are described. Ways and means of overcoming this problem without introducing other problems, are considered. The drying of industrial coal in the consumers' premises, on its way to a combustion process, and the concept of a steam-heated screw dryer for this duty, are described. A prototype steam-heated screw dryer has been designed, fabricated and tested with

small coal containing various levels of moisture. At a throughput of 1.6 tonnes of coal per hour, the total moisture of the coal is reduced to between 20 and 21%, largely independent of the moisture level of the coal feed to the dryer. In the tests, the maximum level of total moisture in the coal feed was 28.3%. At a moisture level of 20-21%, the coal product is considered to be satisfactory for trouble-free use in stokers and pulverisers. There is an inbuilt limitation in the drying system which prevents the complete removal of surface moisture and avoids the attendant problems. The promising results from these relatively-brief tests, will be confirmed with the installation of the dryer in a commercial situation, where it can be tested over long periods of continuous operation. (Available from IEA Coal Research, quote ICTIS/M0170)

8238 **(ICTIS/TR—27) Equipment for hydraulic handling of coal.** Stewart, D.; Wood, P. (International Energy Agency Coal Research, London (UK)). Aug 1984. 76p. International Energy Agency Coal Research, London, England.

This report is one of two that review the literature relating to the hydraulic handling of coal. It is concerned with aspects of equipment selection and slurry characteristics, while the companion report is concerned with operations where hydraulic systems could be used. Aspects of coal and slurry preparation and storage are considered with equipment such as feeder-breakers, crushers, storage tanks, storage ponds, bins, hoppers and silos being outlined. The important problems of pump selection and operation are discussed and the main characteristics of many pumps and pumping systems summarised. The various optional conduits (both closed and open) within which the coal slurry can flow are also briefly considered, as is the problem of slurry dewatering. Recent trends in the development of instrumentation for a hydraulic handling system are then outlined, with methods for velocity and flow measurement, and density and particle size distribution determination being considered. Slurry flow characteristics are next discussed with the various flow regimes being identified. The various methods for the prediction of deposition critical velocities and pipeline friction losses in both laminar and turbulent flow are also reviewed. This is followed by a summary of experiments with coarse coal slurries and dense-phase slurries. It is concluded that increased success of hydraulic handling systems for coal requires a careful choice of equipment used in slurry preparation, handling and dewatering, and that further evaluation of slurry rheology will permit optimisation. (349 refs.)

8239 **(PB—85-106136/XAD) Slurry transport in pipe networks. Final report.** Wood, D.J. (Kentucky Univ., Lexington (USA). Inst. for Mining and Minerals Research). Mar 1979. 51p. (IMMR—44-RRR7-79). NTIS, PC A04/MF A01.

Sponsored in part by Kentucky Energy Cabinet, Lexington.

This report develops the relationships needed to analyze steady flow of a solid-liquid slurry in a network of pipes. The relationships include the basic slurry flow equations for a pipe network and an additional set of equations for continuity- of the solid phase. Special relationships for solids injectors and separators are developed. A computer program which utilizes the theoretical expressions was also developed and tested for use as a design aid for slurry hydrotransport systems.

8240 **An overview of U.S. Department of Energy Coal Preparation Research.** Hucko, R.E. (Pittsburgh Energy Technology Center, Pittsburgh, Pennsylvania). *Preprint, Society of Mining Engineers of AIME;* **84-105**: 6(Feb 1984). (CONF-840218—).

From 113. annual meeting of the American Institute of Mining, Metallurgical and Petroleum Engineers; Los Angeles, CA, USA (26 Feb 1984).

The principal thrust of the U.S. Department of Energy (DOE) Coal Preparation R & D Program is to develop technology to reduce the ash and sulfur contents of United States coals to levels such that the resultant product can be formulated into a high quality solid or slurry fuel that could replace oil or natural gas in both new and retrofit applications. Specifically, the objective is to develop and refine cost-effective physical and chemical beneficiation processes to extract 85-95 percent of the total sulfur and ash. The Coal Preparation program is implemented by the Pittsburgh Energy Technology Center (PETC) and is conducted both in-house and by a cross section of industrial organizations, universities, and national laboratories. Research is subdivided into three areas - coal characterization, beneficiation, and ancillary unit operations. This paper provides a brief overview of many of the research projects being carried out in these areas in fiscal year 1984.

8241 **Coal preparation by high-gradient magnetic separation.** Cox, J.N.; Keyser, R.L.; Tonty, L.V. (Tennessee Valley Authority, Office of Power, Division of Energy Demonstrations and Technology). *Preprint, Society of Mining Engineers of AIME;* **84-161**: 22(Feb 1984). (CONF-840218—).

From 113. annual meeting of the American Institute of Mining, Metallurgical and Petroleum Engineers; Los Angeles, CA, USA (26 Feb 1984).

The Tennessee Valley Authority (TVA) in conjunction with the Department of Energy (DOE) has tested High-Gradient Magnetic Separation (HGMS) extensively since 1979. As the latest phase of this test work, a 1 Mg/hr pilot plant has been constructed at TVA's Paradise Coal Preparation Plant (PCPP). Objectives in operating the facility are: to determine how well HGMS can reduce ash and sulfur in coal while still maintaining an acceptable heating value recovery; and to compare HGMS to froth flotation, which is the method used at the PCCF to clean fine coal. Smaller ones, so the presence of agglomerated particle groups could cause some loss of efficiency. In addition, if the attraction between nonmagnetic and magnetic particles is stronger than the attraction between the magnetic particle and the magnetized screen, the magnetic particle will tend to be washed through the carousel into the product. Agglomerating chemicals from the thickeners could be present in plant slurry or clarified water. Previous HGMS samples run on DOE's batch unit had been dried and then diluted with tap water, so agglomerating chemicals might have been lost or been present in insufficient quantity to affect the separations. Preparations are being made to send samples of representative plant slurry and clarified water to the Pittsburgh facility. These samples will be tested and results compared with those recorded earlier. In addition, a dispersant will be added during some of these batch tests to see if removals can be improved.

8242 **(CE-Trans—7862) Explosion experiments on a Babcock HS beater mill with centrifugal classifier and raw coal feed.** Bärtknecht, W. Translated from *VGB Kraftwerkstechnik ;* **61**: No. 12, 1001-1013(Dec 1981). 33p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85900177. DE85900177

On behalf of Deutsche Babcock AG, Oberhausen, a HS beater mill with a capacity of 5 t/h with centrifugal classifier and raw coal distributor was subjected to dust explosion testing. In a first series of experiments in which the grinding plant was merely pressure relieved via pulverized coal pipes, it was found that in principle, higher levels of reduced explosion pressure were observed in the distributor than in the mill itself. The distributor was destroyed in the end at a pressure of 2.6 bar. When a specific relief system was mounted on the distributor in a second series of tests, the distributor was subjected to less pressure than the pulverizer itself. Furthermore, explosion pressures overall were reduced in comparison with the first series of tests. From the data, conclusions are drawn concerning recommended pressure pulse resistance of HS beater mills.

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REFER ALSO TO CITATION(S) 0140008173, 8176, 8212, 8235, 8783, 8790, 8871, 8948, 8949

8243 (CONF-8404199—, pp vp) **Comparison of emissions from waste air discharge obtained with refuse dual-purpose power plants, coal-fuelled power plants and domestic firing installations.** Angerer, G.; Boehm, E.; Schoen, M. 1984. (In German). NTIS (US Sales Only), MF A01. File Number TI85770037.

From 4. colloquium on waste management; Saarbruecken, F.R. Germany (26 Apr 1984).

The paper on hand compares the waste-air emissions of direct combustion of the fuels fuel oil type EL, natural gas and coal for heat generation in domestic firing installations with the emissions originating in district heating and electricity generation in coal-fuelled and refuse-fuelled dual-purpose power plants. With the latter, statements are restricted to facilities for refuse combustion/incineration.

8244 **(DOE/ET/10393—1620) Investigation of bed ash agglomeration during the screening tests.** (NCB (IEA Grimethorpe) Ltd., Grimethorpe, Barnsley, South Yorkshire (UK)). Jul 1984. Contract AI01-76ET10393. 114p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85001999.

After extensive testing of the UK coal/sorbent mixture in the Experimental Pressurized Fluidized Bed Combustion Facility at Grimethorpe, South Yorkshire, UK, a series of 100-hour tests was carried out to characterize one USA and two FRG fuel blends. During these tests, bed ash agglomeration occurred within the in-bed tube bank and in the space between the tube bank and the distributor plate. As this phenomenon had not occurred during testing with the UK fuel blend, an investigation was initiated. The fuel blend properties and the design and operation of the combustor were reviewed. The investigation revealed that the agglomeration was most likely the result of poor mixing in the bed caused by local regions of less than adequate fluidization. Suspected causes of this poor fluidization immediately above the distributor plate were the absence of fluidizing nozzles in the region of the refractory lined ash off-take point and a mismatch during the early stages of start-up between the fluidizing velocity and the minimum fluidizing velocity of the larger particles present in the bed. The severity of the agglomeration once the necessary high temperatures were being generated was found to be a function of the ash fusion characteristics of the bed material. It is important to note that it is the fusion characteristic of the bed material and not the coal which was found to be important. This meant, for example, that in the tests with the US feedstock where the ash fusion temperature of the coal was low, the degree of agglomeration was fairly small because the bed, which was predominantly sorbent derived, had a high ash fusion temperature. The plant start-up procedure was subsequently modified and additional air nozzles were fitted around the ash off-take to reduce the likelihood of further problems resulting from ash agglomeration.

8245 **(DOE/ET/10393—1621-Vol.1) Screening tests report. Volume I.** (NCB (IEA Grimethorpe) Ltd., Grimethorpe, Barnsley, South Yorkshire (UK)). Jul 1984. Contract AI01-76ET10393. 327p. NTIS, PC A15/MF A01; 1; GPO Dep. File Number DE85001978.

A Pressurized Fluidized Bed Combustion (PFBC) Experimental Facility has been established by UK, US and FRG Sponsors under the auspices of the International Energy Agency at Grimethorpe, South Yorkshire, England. The objective is to study combustion, sulfur removal, heat transfer, emissions, gas clean-up, corrosion and energy recovery in PFBC systems. The facility has undergone a number of modifications as a result of experience gained in a program of experimental operation with a UK datum coal and sorbent. Before making further planned modifications, and embarking on a program of experimental operation with US and FRG coal/sorbent combinations, a short series of tests was performed to establish the basic combustion parameters and to forewarn the project of any operational problem related to particular coal/sorbent combinations. This series of tests, the Screening Tests, is described in the present report. Bed material agglomerated during some of the Screening Test runs, and the operating conditions were altered from those originally planned in an attempt to minimize the occurrence. It is now believed that agglomeration resulted from changes that had been made to combustor design details and start-up procedures in an attempt to alleviate tube bank metal wastage. These factors have been subsequently corrected. The data obtained over the revized range of operating conditions included those relating to combustion and sulfur retention performance, in-bed tube bank metal wastage, gaseous and particulate emissions and the behavior of static turbine blades in a cascade. The information provided, in advance of the comprehensive series of tests with the US and FRG coal/sorbent combinations, the preliminary characterization required.

8246 **(DOE/ET/10393—1621-Vol.2) Screening tests report. Volume II. Appendices.** (NCB (IEA Grimethorpe) Ltd., Grimethorpe, Barnsley, South Yorkshire (UK)). Jul 1984. Contract AI01-76ET10393. 159p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85001979.

8247 **(DOE/ET/10393—1622) Performance of the combustor distributor plate. Status report, March 1984.** (NCB (IEA Grimethorpe) Ltd., Grimethorpe, Barnsley, South Yorkshire (UK)). Sep 1984. Contract AI01-76ET10393. 54p. NTIS, PC A04/MF A01; GPO Dep. File Number DE84011988.

At the heart of a pressurized fluidized bed combustion combined cycle power plant is the combustor. Good performance and reliability are essential. In the three year history of the plant covering some 3000 hours of operation with several fuels, the Grimethorpe Experimental Facility's combustor has undergone several modifications to its components. Modifications to the distributor plate were necessary to overcome poor sealing between the plate and the waterwalls, and to improve the uniformity of air distribution entering the combustor. The design of an air seal in the freeboard region of the fluidized bed was also improved. 2 references, 24 figures.

8248 **(DOE/ET/10393—1657) Test Series 2.4: detailed test plan.** (NCB (IEA Grimethorpe) Ltd., Grimethorpe, Barnsley, South Yorkshire (UK)). Sep 1984. Contract AI01-76ET10393. 107p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE84012000.

Test Series 2.4 comprises the fourth sub-series of tests to be scheduled as a part of Test Series 2, the second stage of the combustion research program to be carried out at the Grimethorpe Experimental Pressurized Fluidized Bed Combustion Facility. Test Series 2.1, the first sub-series of tests, was completed in February 1983, and the first part of the second sub-series, Test Series 2.3, in October 1983. Test Series 2.2 was completed in February 1984 after which the second part of Test Series 2.3 commenced. The Plan for Test Series 2.4 consists of 350 data gathering hours to be completed within 520 coal burning hours. This document provides a brief description of the Facility and modifications which have been made following the completion of Test Series 2.1. No further modifications were made following the completion of the first part of Test Series 2.3 or Test Series 2.2. The operating requirements for Test Series 2.4 are specified. The tests will be performed using a UK coal (Lady Windsor), and a UK limestone (Middleton) both nominated by the FRG. Seven objectives are proposed which are to be fulfilled by thirteen test conditions. Six part load tests based on input supplied by Kraftwerk Union AG are included. The cascade is expected to be on line for each test condition and total cascade exposure is expected to be in excess of 450 hours. Details of sampling and special measurements are given. A test plan schedule envisages the full test series being completed within a two month calendar period. Finally, a number of contingency strategies are proposed. 3 figures, 14 tables.

8249 **(DOE/ET/10393—1658) Materials-related problems and investigations during Test Series 1.** (NCB (IEA Grimethorpe) Ltd., Grimethorpe, Barnsley, South Yorkshire (UK)). Sep 1984. Contract AI01-76ET10393. 294p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE84011999.

At the Experimental Pressurized Fluidized Bed Combustion Facility at Grimethorpe, South Yorkshire, UK, tests have been carried out over a wide range of operating conditions with the intent of developing a comprehensive set of PFBC performance data on combustion efficiency, sulphur retention, gaseous emissions, heat transfer, hot gas clean-up and component reliability, using a variety of coals. The materials monitoring and evaluation program is a part of the overall experimental program, and has the objectives of materials testing and evaluation, component monitoring and component failure analysis. This report describes the results of the materials program for the period of operation of the Facility from September 1980 to December 1981. Areas addressed in this report include the erosion and corrosion of a variety of uncooled metal alloy specimens, located at various positions within the bed: erosion, and a sulphation-oxidation type of corrosion are in evidence

and the corrosion potential generally decreases with height above the distributor plate. The erosion of the in-bed tube bank was measured at the end of the operating period and wastage rates of approximately 0.1 to 0.3 mm/1000 h were observed. The performance and high temperature valves for the control of solids flow are described. Measures have been taken to improve the reliability of these components. 49 references, 37 figures, 12 tables.

8250 **(DOE/PC/40271—T1) Fundamental study of NO/sub x/ reduction processes during staged combustion of pulverized coal. Technical progress report, January-March 1982.** Yang, R.J. (KVB, Inc., Irvine, CA (USA). Research Applications Div.). Apr 1982. Contract AC22-81PC40271. 54p. NTIS, PC A04. File Number DE85004370.

This project is being conducted to investigate NO/sub x/ reduction processes during the staged combustion of pulverized coal. This report describes the progress of technical activities in the quarter of January through March, 1982. Test apparatus includes a test furnace, pulverized coal burner, air preheater, heat exchanger, and baghouses. Sampling and monitoring equipment are described. A detailed test plan was devised to investigate the effects of a set of system input parameters on NO/sub x/ emissions during staged combustion. The test plan and parameters are described. Preliminary results are presented. (DMC)

8251 **(DOE/PC/40275—T1) Combustion characteristics of synthetic liquid fuels. Quarterly technical progress report, August 21-December 31, 1981.** Beer, J.M. (Massachusetts Inst. of Tech., Cambridge (USA)). Jan 1982. Contract AC22-81PC40275. 81p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85004106.

First quarter work carried out on three closely-related and interacting Project Elements is reported. Experimental work in the MIT Combustion Research Facility (CRF) was concentrated on diagnostics to be used for the study of turbulent flames in that facility, burning SRC-II middle distillate. Parallel experiments were carried out on a flat-flame burner; temperature and C_1, C_2, and C_3 species mole fraction measurements were completed in four fuel-rich, ethylene/air flames, thereby enabling a comparison of measured hydrocarbon burn-out rates with those prediced by a C_1/C_2 kinetic model. The predictions for methane and acetylene oxidation are in reasonable ageement with the measurements, although predicted acetylene decay rates are always slightly low. Initial work is presented on development of an exisymmetric flame model of fuel-nitrogen conversion in turbulent diffusion flames, as in the CRF. The coherent flame theory of Marble and Broadwell for a turbulent diffusion flame is formulated in terms of elementary calculations of stretched flame sheets. Compressibility effects and heat release from chemical reactions are included; realistic transport coefficients are used to compute the reactant profiles in the preheating zones more accurately. The theory is extended to model the burn-out process of a fuel (oxidizer) eddy in an excess oxidizer (fuel) region. A status review is also provided on existing CSTR/Plug-Flow modeling capability and its application to modeling of chemical kinetics in staged combustion in the CRF. Conclusions drawn from previous studies using these models are discussed. 13 references, 18 figures, 3 tables.

8252 **(DOE/PC/40286—10) Development of laser spectroscopy for combustion applications. Final technical report.** Ivancic, W.A.; Brown, L.L.; Barnes, R.H. (Battelle Columbus Labs., OH (USA)). 7 Nov 1983. Contract AC22-81PC40286. 42p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85003874.

Nonintrusive laser-fluorescence techniques were investigated for detecting species and measuring their concentrations in flames. Fluorescence measurements were made for OH and CH radicals in atmospheric-pressure flames. Lifetime measurements were made of the decay of the fluorescence from OH and CH excited with a pulsed dye laser. Lifetimes measured in an atmospheric-pressure flame for these two radicals was in the range of 3 to 4 ns while the radiative lifetimes run about 700 ns. Use of the lifetimes in flames in combination with the radiative lifetimes of the species measured was evaluated as a means for correcting for the collisional quenching of the fluorescence to obtain species concentrations. Fluorescence measurements were also made for OH radicals and SO_2 in a methane/air flame containing powdered coal to demonstrate the utility of the fluorescence techniques for the study of coal-combustion phenomena. 7 references, 22 figures.

8253 **(DOE/PC/50268—1) Fuel Staging NO/sub x/ Control Test Program. First quarterly report, September 15-December 15, 1982.** Suttmann, S.T.; Brown, R.A.; Kelly, J.T. (Acurex Corp., Mountain View, CA (USA). Energy and Environmental Div.). 15 Jan 1983. Contract AC22-82PC50268. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004216.

The first quarter results under the Fuel Staging NO/sub x/ Control Test Program (DOE Contract DE-AC-82PC50268) are reported. The facility has been refurbished and a number of operational improvements and features have been added. The facility now has the capability to inject dilution gases (N_2) at any of the air injection locations. Fuel staging with doped gas is now also possible. The fuels to be tested have been selected and purchased. These include the baseline Utah coal, North Dakota lignite, high-sulfur bituminous coal and a coal char made from the Utah coal. A size split has also been made on a portion of the Utah coal to study particle size effects. Test plans have been outlined for baseline testing, primary variable testing, multiple variable testing, optimization, and fuels testing. The principal variables to be tested in this program include heat absorption, particle size, dilution, and coal type. The baseline testing is nearly complete. Good agreement was found with the prior work for both fuel staging and nonstaging conditions. The effect of fuel fraction for both natural gas and coal as the second stage fuel was tested. Low-NO/sub x/ emissions could still be obtained with only 25% of the fuel injected into the second stage. Similar results were obtained for gas as the second-stage fuel. Little effect on NO was noted for variations in third-stage stoichiometry. A number of gas only predictions have been made using the PROF code to study the effects of initial NO concentration, fuel nitrogen content of the second-stage fuel, and second-stage stoichiometry.

8254 **(FWC/FWDC/TR—83/10) Investigation of pyrite as a contributor to slagging in eastern bituminous coals. Quarterly progress report 7, April 1-June 30, 1983.** Bryers, R.W. (Foster Wheeler Development Corp., Livingston, NJ (USA)). Sep 1983. Contract AC22-81PC40268. 66p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85004230.

The objective of this program is to examine slags formed as a result of firing coals with varying concentration levels, size, distribution, and orientation of pyrite with regard to mineral matter in the coal in a laboratory furnace. The program tasks are: (1) selection of eight candidate coals; (2) chemical characterization of the coal samples and identification of the pyrite size, distribution, and orientation with respect to other mineral matter and concentration levels; (3) testing of the candidate coals in a laboratory furnace; (4) chemical and physical characterization of the slag and fly ash samples created by the impurities in the coal sample; (5) influence of coal beneficiation on furnace slagging; and (6) analysis of data and identification of parameters influencing the contribution of pyrite to slagging problems. During the second quarter of 1983, characterization of Kentucky No. 9 was completed in Task 2. A combustion test on the same coal was conducted, and the deposits formed were analyzed as part of Tasks 3 and 4. Analysis of washabiltiy tests on Upper Freeport coal from Indiana County in Pennsylvania, was completed, and washing of a 2000-lb sample was begun. 23 figures, 11 tables.

0150 Marketing And Economics

REFER ALSO TO CITATION(S) 0150008152, 8290

8255 **(DOE/EIA—0462) Coal-exporting countries: the Asian market.** Tukenmez, E.; Tuck, N. (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 13 Dec 1984. 43p. NTIS, PC A03/MF A01; 1 - GPO; GPO Dep. File Number DE85004910.

Between 1973 and 1983, international coal trade rose from 191 million short tons to 284 million short tons, and coal imports by

Asian countries increased from 63 million short tons to 102 million short tons. Before 1979, steam coal was not traded or consumed in substantial quantities in the coal-importing Asian countries; however, by 1983 these countries imported 27 million short tons of steam coal. In most of these countries, the steam coal trade developed as an outgrowth of the predominant metallurgical coal trade. Although steam coal represents a growing share of Asian coal trade, metallurgical coal still represents nearly three quarters of that trade. Asian coal imports are expected to grow significantly over the next decade. In an earlier report, the Energy Information Administration (EIA) projected that Asian coal imports will rise to 152 million short tons in 1990 and to 185 million short tons in 1995. Most of that increase will be in the steam coal market. By 1995, steam coal imports are projected to equal metallurgical coal imports in Asia. This report analyzes the coal industries of the major competitors of the United States in the Asian market: Australia and Canada. The structure of their coal industries is examined in terms of the links that comprise the coal supply chain. The coal industries of potential or smaller-scale suppliers - China (the People's Republic of China), the USSR, South Africa, and Colombia - are also examined. 56 references, 4 figures, 7 tables.

0160 Health And Safety

REFER ALSO TO CITATION(S) 0160008212, 8218, 8223, 8232, 9085

8256 **(PB—84-239136) Immunological parameters of coal workers' pneumoconiosis. Final report.** Mentnech, M.S.; Major, P.C. (National Inst. for Occupational Safety and Health, Morgantown, WV (USA). Appalachian Lab. for Occupational Safety and Health). 1 Aug 1978. 81p. NTIS, PC A05/MF A01.

An immunological and immunogenetic investigation of coal worker's pneumoconiosis (CWP) was conducted. Four geographic regions of study were established, depending on the type of coal mined in the region. Blood samples were taken from 358 workers with no disease, simple CWP, or complicated CWP. Samples were tested for histocompatability, blood type, antisera, passive hemagglutination, and antinuclear antibodies. There were no significant differences in the distribution of human leukocyte antigen (HLA) between the segments representing each geographic region. The frequency of the HLA-A-1 antigen was Significantly greater in the no disease category than in CWP categories. No other significant differences in HLA antigens were noted. Marked regional differences occurred for ABO system and MN system antigens; group-A was significantly lower in the central region and group AB was increased. The southern region showed a decreased frequency of Gm phenotype. No significant differences in disease categories were noted between regions. The authors conclude that there is a significant negative association between HLA-A-1 antigen and CWP. Ethnic differences are reflected in blood group antigens. No significant differences in other immunological parameters are seen.

8257 **(PB—84-239391) Mining environmental target investigation: welding operations at underground and surface coal mines. Final report.** Albers, A. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jan 1982. 79p. NTIS, PC A05/MF A01.

A target investigation was conducted to determine adverse health effects of inhalation contaminants produced during welding processes. The immediate effects of acute exposure to welding fumes are metal fume fever and eye and throat irritation from ozone (10028156), nitrous oxides, and fluorides. A death certificate survey showed a higher risk of lung cancer death among welders, operators, boilermakers, painters, and oilfield workers. Hardfacing operations resulted in overexposures to inorganic nickel (7440020), hexavalent chromium (7440473), and nitrogen-dioxide (10102440). Shielded metal arc welding or gas welding were used in 82 percent of mine welding operations. Most welding was done on mild and low alloy steels. Most worker complaints resulted from lack of adequate ventilation; few underground welding shops were used, most underground operations were limited to repairs, except for installation of new machinery. Underground welding was always kept to a minimum. Samples were collected in bucket houses at two strip coal mines and at an underground coal mine. None of the NIOSH recommended limits was exceeded by any of the samples.

8258 **(PB—84-241488) Health hazard evaluation report No. HHE-71-037, Hanna Coal Company, Cadiz, Ohio. Survey report.** LaPallo, F.J. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Technical Services). 25 Feb 1972. 19p. (HHE—71-037). NTIS, PC A02/MF A01.

A survey was conducted to determine worker exposures to asbestos (1332214) dust at the Hanna Coal Company (SIC-1211) in Cadiz, Ohio, on November 22 and 23, 1971. The survey was requested by the director of the United Mine Workers Department of Occupational Health. Personal samples were taken in the breathing zones of eight welders, and 14 environmental samples were taken to determine exposures to asbestos dust evolved from asbestos cloth and as insulation in the welding process. Analysis of welding fumes showed atmospheric concentrations of contaminants were below threshold limit values in all cases. The author recommends a portable welding exhaust arrangement to remove fumes from the breathing zone of workers.

0170 Legislation And Regulations

REFER ALSO TO CITATION(S) 0170008194, 8197, 8202, 8214, 8222

8259 (UKY-BU—133, pp 201-206) **Impact and current status of federal and state environmental regulation of coal mining.** McGraw, M.P. Dec 1983. University of Kentucky, Lexington, USA. (CONF-831162—).

From National symposium on surface mining, hydrology, sedimentology and reclamation; Lexington, KY, USA (28 Nov 1983).

Few areas of the law which affect the coal industry are changing more rapidly than the environmental regulation of the coal industry. Changes at the US Department of the Interior, the US Environmental Protection Agency, and within the various coal states are highlighted, and the important events relating to the environmental regulation of coal are summarized.

02 PETROLEUM

8260 **(DOE/EI/19646—T6) Petroleum Data System (PDS) monthly report, November 1-30, 1984.** Fleming, M.L. (Oklahoma Univ., Norman (USA). Energy Resources Inst.). 12 Dec 1984. Contract AS04-84EI19646. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004201.

Progress accomplished during the month of November 1984 is summarized. During this report period, the coding on the Louisiana offshore records was completed by the PDS Dallas Field Office (DFO) staff, and work began on the Wyoming Symposium Volume. A staff meeting was held with the PDS DFO staff on November 5, 1984 to discuss processing plans for the Wyoming Project. A copy of the meeting report is attached.

8261 **(NP—5750440) Annual report 1982.** (Oljedirektoratet, Stavanger (Norway)). 1983. 214p. NTIS (US Sales Only), PC A10/MF A01. File Number TI85750440.

The first chapter concerns the Directorates task, board of directors and management. The main part of the report deals with the drilling and production activity on the Norwegian continental shelf, safety control and petroleum economy. Geophysical and geological surveys, exploration and appraisal wells, finds and fields being evaluated are included. Details such as concession holders, production facilities, recovery of reserves, metering systems and costs are treated for the following fields: The Ekofisk area, Ula, Heimdal, the Frigg area, gulfaks, the Statfjord area, and Murchinson. Included are also chapters on future activity and international cooperation, and two technical papers. Health problems connected with diving, accidents and accident prevention in connection with diving. The last chapter contains statistics on production of oil and gas and royalties. 58 drawings, 50 tables.

8262 **(NP—5770027) Basic oil industry information.** (Organization of the Petroleum Exporting Countries, Vienna (Austria)). 1983. 41p. NTIS (US Sales Only), PC A03/MF A01. File Number TI85770027.

T...e major concepts of the mineral oil industry are presented and defined with the aid of many figures.

0202 Geology And Exploration

REFER ALSO TO CITATION(S) 0202008305, 8311, 8313, 8314, 8315, 8323, 8680

8263 (DOE/ER/13013—2) Investigations of the thermal evolution of sedimentary basins using $^{40}Ar/^{39}Ar$ thermochronology: applications to petroleum exploration. Progress report, April 1, 1983-March 31, 1985. Harrison, T.M. (State Univ. of New York, Albany (USA). Dept. of Geological Sciences). Nov 1984. Contract AC02-82ER13013. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004281.

$^{40}Ar/^{39}Ar$ age spectrum analyses of microclines separated from a variety of deep drill cores (Albuquerque Basin, New Mexico; Fenton Hill, New Mexico; North Sea) have been confirmed the viability of using detrital microcline as a monitor of the thermal evolution of sedimentary basins, and provided new understanding of the response of this system to a variety of geological environments. Results from the Albuquerque Basin yield a model thermal history which integrates well with the existing view of basin evolution. Age spectra of basement microclines from deep drill holes at Fenton Hill, New Mexico, reveal surprisingly short estimates of heating duration that confirms a recent analysis of the local heat flow. Preliminary results on North Sea samples suggests that while useful thermal information can be obtained using this approach on samples at temperatures hovering about 100°C, temperatures greater than 115°C are required to produce sufficient $^{40}Ar^{*}$ loss for an unambiguous thermal analysis. Improvements in extraction furnace design have allowed better resolution of inter-sample variability of Ar diffusion parameters calculated from ^{39}Ar loss during heating ($\sim$ 33 to 37 kcal-mol^{-1}). 6 references, 6 figures.

8264 (PB—84-246453) Geological and operational summary, Navarin Basin cost number 1 well, Bering Sea, Alaska. Final report. Turner, R.F.; McCarthy, C.M.; Steffy, D.A.; Lynch, M.B.; Martin, G.C. (Minerals Management Service, Anchorage, AK (USA). Alaska Outer Continental Shelf Region). Aug 1984. 246p. (OCS/MMS—84/0031). NTIS, PC A11.

The report discusses the first continental offshore stratigraphic test (COST) well drilled in the Navarin Basin. The well was drilled to determine the hydrocarbon potential of the area covered by OCS (Outer Continental Shelf) Lease Sale 83, held in April 1984. The report covers drilling operations, shallow geology and geohazards, paleontology and biostratigraphy, lithology, velocity analysis, seismic stratigraphy, the bottom-simulating reflector, well log analysis, abnormal pressure, geothermal gradient, organic geochemistry, and environmental considerations. The report synthesizes the regional geology and basin evolution in light of the subsurface data available from this large potential petroleum province.

8265 (HSE-Trans—7298) Noise abatement devices for drilling platforms for oil and gas exploration and extraction (according to noise level calculations by computer). Duganov, G.V.; Maksimova, V.V. (Sevastopol'skij Priborostroitel'nyj Inst. (Ukrainian SSR)). 26 May 1982. Translation source information not available . (CONF-7710198—6-Trans.). 9p. NTIS (US Sales Only), PC A02. File Number TI84901845.

From 17. international conference of mining safety research; Varna, Bulgaria (3 Oct 1977).

Detailed analysis using differentiated approach to the assessment of the role of various noise sources in specific conditions on a floating platform, application of computer for calculations of the noise expected and an assessment of the effectiveness of various soundproofing measures developed, additional acoustic investigations carried out during platform construction and commissioning periods made it possible to develop for the whole series of the platforms discussed complex soundproofing measures contributing to an increase in safety and improvement in the living conditions of the crew, as well as an increase in productivity.

0203 Drilling And Production

REFER ALSO TO CITATION(S) 0203008288, 8894, 8895, 8896, 8954

8266 (DOE/BC/10082—25) Adsorption from flooding solutions in porous media. A study of interactions of surfactants and polymers with reservoir minerals. Quarterly report, July-September 1984. (Columbia Univ., New York (USA). School of Engineering and Applied Science). Sep 1984. Contract AC19-79BC10082. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003900.

The concentration of surfactant solutions inevitably varies as the micellar slug advances through the reservoir. The adsorption behavior of a multicomponent surfactant was therefore investigated under changing concentration conditions by conducting tests through incremental increases in surfactant concentration. In addition to surfactant concentration analysis, HPLC was used to monitor changes in the relative composition of the multicomponent surfactant mixture that may accompany adsorption. Adsorption results were generated in two different manners: (1) Batch tests - sulfonate solutions of varying concentration contacted with mineral samples (B-isotherms); and (2) step-wise increase - sulfonate-mineral supernatant, obtained by contacting mineral with sulfonate at high sulfonate concentration, was added in increments to mineral suspensions of various sulfonate concentration (batch tests) including samples containing mineral-electrolyte only, i.e., zero sulfonate (S-isotherms). Results are given for both the B-isotherm and S-isotherms for the dodecylbenzene sulfonate (DDBS)-alumina system under the given conditions of pH, ionic strength and temperature. Preferential adsorption thus has been observed in the DDBS/alumina system and can be expected in all systems where the surfactant consists of components that vary in activity. Chromatographic separation of surfactant components can have a major effect on flooding efficiency in EOR systems and further experiments are in progress using synthetically prepared mixtures of known surfactants to test the role of chromatographic separation on the adsorption behavior of such mixtures. 4 figures.

8267 (DOE/BC/10345—2) Tertiary oil recovery processes research at the University of Texas. Annual report, October 1981-September 1982. Schechter, R.S.; Wade, W.H. (Texas Univ., Austin (USA)). Jan 1985. Contract AS19-80BC10345;AC19-79BC20001. 194p. NTIS, PC A09/MF A01. File Number DE85000112.

During the past year we have continued three major projects: (I) further delineation of surfactant adsorption mechanisms, (II) the systematics of chromatographic separation processes, and (III) the design and evaluation of surfactants. In I we have: (a) explored surface condensed structures and plateau adsorption levels; and (b) expanded absorption theory to encompass heterogeneities, studied the critical admicelle concentration and multicomponent adsorption. In II we have traced the composition path for several pure alkyl benzene sulfonates in the grid diagram and examined surfactant wave fronts. In III we have developed two and quantitative surfactant synthesis schemes and finished studies on α-olefin sulfonates, ethoxylated oleyl sulfonates and alkane sulfonates. The following 5 papers in III have been processed for inclusion in the Energy Data Base: (1) synthesis and performance of isomer-free secondary alkane sulfonate surfactants; (2) synthesis and performance of linear monoisomeric ethylene oxide sulfonate surfactants; (3) alpha-olefin sulfonates for enhanced oil recovery; (4) ethoxylated oleyl sulfonates as model compounds for enhanced oil recovery; (5) phase behavior of simple salt tolerant sulfonates.

8268 (DOE/BC/10345—2, pp 126-146) Alpha-olefin sulfonates for enhanced oil recovery. Barakat, Y.; Fortney, L.N.; Schechter, R.S.; Wade, W.H.; Yiv, S.H. Jan 1985. NTIS, PC A09/MF A01. File Number DE85000112.

In Tertiary oil recovery processes research at the University of Texas. Annual report, October 1981-September 1982.

C_{18} and C_{20} α-olefin sulfonates and the components of the C_{18} species, the alkene and hydroxy sulfonates, have been studied for potential EOR application. The phase behavior, solubilization parameters, and interfacial tensions augur well for them as candidates. Their only bad feature thus far discovered is a tendency to

form liquid crystals; however, these extended structures can be destroyed by alcohol or melted at elevated temperatures in order to obtain classical microemulsion phase behavior. 13 references, 11 figures.

8269 (DOE/BC/10345—2, pp 165-183) **Phase behavior of simple salt tolerant sulfonates.** Barakat, Y.; Fortney, L.N.; LaLanne-Cassou, C.; Schecter, R.S.; Wade, W.H.; Weerasooriya, U.; Weerasooriya, V.; Yiv, S. Jan 1985. NTIS, PC A09/MF A01. File Number DE85000112.

In Tertiary oil recovery processes research at the University of Texas. Annual report, October 1981-September 1982.

Alkane and α-olefin sulfonates can be utilized to produce optimal microemulsion formulation having very high salinity (including divalent ion) tolerance while maintaining large solubilization parameters and low interfacial tensions. Such molecules require elevated temperatures or higher alcohol concentrations to suppress liquid crystal formation. As found for other species, solubilization is inversely related to width of the three phase regime, and interfacial tension and solubilization are strongly coupled. 28 references, 4 figures.

8270 (DOE/BC/10345—4) **Research on enhanced oil recovery processes. Quarterly technical progress report, July-September 1984.** Schechter, R.S.; Wade, W.H. (Texas Univ., Austin (USA)). 1984. Contract AS19-80BC10345. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003916.

Monomer-micellar equilibrium - the investigators found the mixed anionic-nonionic micelle to be highly structured rather than randomly mixed as is required by regular solution theories. This structure means that the entropy of mixing is large and the interaction parameter must be correspondingly increased to fit the data. Thus heats of mixing anionic micelles with nonionic micelles to form mixed micelles is larger by a factor of nearly two layers than previously thought. Attempts are being made to measure this predicted heat of mixing. Surfactant structure - the interior alkane sulfonate ethoxylates have proven to be excellent surfactants for application without alcohol. A graph with 4 curves is presented showing the solubilization parameter at optimum conditions as a function of salinity. Each curve represents a different surfactant. The important results shown in this graph is that at 40°C, it is possible, to accommodate an oil of any ACN between 8 and 14 at any salinity between 1 gram of salt per deciliter of water gpdl to 20 gpdl without using any alcohol to help balance the surfactant system. Because the surfactants used in the blend would have similar structures, it is anticipated that the selective partitioning between oil and water of one surfactant as compared to the other would be minimal. 1 figure.

8271 (DOE/ET/12002—96) **Rock Creek carbon dioxide mobility control test. Report for the period January 1, 1984-October 1, 1984.** Boone, D.A. (Pennzoil Co., Vienna, WV (USA)). 1984. Contract AC21-76ET12002. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004354.

The DOE-funded CO_2 Mobility Control Test consists of four phases: I - Initial Water Injection; II - Surfactant Pad Injection; III - CO_2 Foam Injection; and IV - Chase Water Injection. L.W. Shaffer PI-2 was placed on water injection on March 14, 1984 to initiate Phase I. The purpose of this phase is to raise reservoir pressure to 1000 psi which is the minimum pressure necessary to keep carbon dioxide in liquid form. Phase I ended on September 28th when injection of the surfactant pad was started in PI-2. Alipal CD-128, a sulfate ester type anionic surfactant, is currently being mixed with the injection water to form a 0.1% surfactant solution (Phase II). The purpose of the surfactant pad is to allow for the adsorption of the surfactant onto the reservoir rock so that the CO_2 foam will not degrade when Phase III starts. When Phase III begins, CO_2 will be injected as an 80-quality foam. The 20% water phase will consist of a 0.05% surfactant solution. The projected volume of the CO_2 foam is 10,800 Bbls. At the conclusion of CO_2 foam injection, Phase IV will begin with the injection of 6200 Bbls. of chase water. Currently, Shaffer No. 4 is being pumped 2 hours per day to aid in creating preferential fluid movement in the direction of OB-2. 1 figure, 2 tables.

8272 (DOE/ET/12034—T1) **Basic studies in the displacement of residual oil by chemical flooding. Final report.** Flumerfelt, R.W.; Payatakes, A.C. (Houston Univ., TX (USA)). 28 Jun 1984. Contract AS05-76ET12034. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004232.

This report summarizes recent observations on the dynamic interfacial properties and their effects on oil ganglia reconnection during surfactant flooding. Studies have been conducted on a number of oil/brine/surfactant systems. These include tests with iso-octane and crude oil oleic phases and several commercial surfactants. Observations to date indicate large variations in eta = kappa + epsilon, the sum of the interfacial dilation and shear viscosities, depending on salt concentrations. The lowest values of eta are observed in the region of optimal salinity where, typically, values on the order of 10^{-3} s poise, or less, are observed. Outside the region of optimal salinity, significantly larger values are obtained, particularly, at salt concentrations which are below optimal. Droplet-droplet coalescence studies in a spinning drop device also show significant variations in coalescence rate depending on salt concentration. As noted before, the fastest coalescence (or reconnection) is observed in the neighborhood of optimal salinity. Significantly lower rates are observed outside this region with stable emulsions being noted at low salt concentrations. Although surface viscous and elastic effects are important to such processes, it appears that the critical variable is the collapse thickness of the thin film separating adjacent droplets. In general, the results reported here have implications to the kinetics of oil bank formation and to the often observed in situ formation of troublesome stable macroemulsions during surfactant flooding. 14 references, 3 figures.

8273 (DOE/METC—84/4, pp 153-168) **Commercial applications - valve fabrication: electroslag-casting evaluation at Cameron Iron Works.** Raymond, E.L. (Cameron Iron Works, Houston, TX). Mar 1984. NTIS, PC A11/MF A01. File Number DE84003075. (CONF-8306237—).

From Symposium on electroslag component casting; Morgantown, WV, USA (1 Jun 1983).

Electroslag casting technology as a possible manufacturing method for high-integrity components of wellhead equipment, e.g., large values, blowout preventers, chokes, and other auxiliary equipment is discussed. Early analyses of these ESC-produced castings are very encouraging and have prompted the construction of a pilot ESC unit with which further evaluations may be done.

8274 (DOE/METC—84/4, pp 169-186) **Commercial applications - casting techniques: electroslag refining and casting.** Banerjee, B.R. (Ingersoll-Rand Co., Princeton, NJ). Mar 1984. NTIS, PC A11/MF A01. File Number DE84003075. (CONF-8306237—).

From Symposium on electroslag component casting; Morgantown, WV, USA (1 Jun 1983).

The facilities used for the electroslag refining and casting of various alloy systems, particularly high-strength alloy steels such as 4340 and stainless steels, are described. Shape castings are discussed and some of the barriers in the development of this technology are pointed out. It is concluded that the technology has not yet reached the take-off point and further development work is needed to prove the technical and economic feasibility of shaping forms and reproducably making production quantities.

8275 (NIPER—19-Vol.1) **Energy production research, Volume I. Quarterly technical report, July 1-September 30, 1984.** (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). 6 Dec 1984. Contract FC01-83FE60149. 182p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85004363.

Progress of 20 research projects are briefly discussed for the following areas; (1) interaction between reservoir rock and enhanced oil recovery (EOR) fluids; (2) reservoir screening and recovery predictions; (3) EOR environmental compatibility; (4) basic studies for EOR chemicals; (5) recovery process - gas displacement methods; (6) improvements in stimulation technology; (7) reservoir characterization for EOR application; (8) recovery processes - chemical; and (9) recovery processes - thermal.

8276 **(NP—5750408) Enhanced Oil Recovery - EOR. From low permeability carbonate rock reservoirs. Phase 1 - Literature review.** (Cowiconsult Raadgivende Ingenioerer A/S, Virum (Denmark)). Jul 1983. 237p. NTIS (US Sales Only), PC A11/MF A01. File Number TI85750408.

The report outlines the well-known and tested enhanced oil recovery methods (EOR methods). The outline is based on a literature study and information obtained by visits at energy agencies and research institutions in Denmark and Norway. It has been the intention to describe all the well-known EOR methods. Each method has been evaluated for applicability under conditions, in particular to the low-permeable chalk reservoirs in the Danish North Sea. Technical as well as economic aspects are considered. In this report only the reservoir engineering aspects of the EOR methods have been discussed. Furthermore, the purpose has been to point out unsolved problems and questions to be answered for a more detailed evaluation of the application of the methods in Danish oil reservoirs. It is the intention that this report together with the results of further studies shall form the basis for an evaluation of the possibilities for application of enhanced oil recovery techniques in Denmark.

8277 **(PB—85-104123/XAD) Field evaluation of SPT (Standard Penetration Test) energy, equipment, and methods in Japan compared with the SPT in the United States.** Kovacs, W.D.; Salomone, L.A. (National Bureau of Standards, Washington, DC (USA). Center for Building Technology). Aug 1984. 75p. (NBSIR—84/2910). NTIS, PC A04/MF A01.

Field energy measurements on Japanese drill rigs were made during the performance of the Standard Penetration Test to document the difference between Japanese and present U.S. Practice. A total of 78 Standard Penetration Tests were performed using 19 different testing conditions (equipment and operators). Over 2000 data points are reported.

8278 **(SAND—84-7144) Stability of condensation fronts in a porous medium. Final report, January-December 1983.** Krueger, D.A. (Colorado State Univ., Fort Collins (USA). Dept. of Physics). Jun 1984. Contract AC04-76DP00789. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004110.

The stability of the condensation front in a porous medium has been investigated. Previous work on gravity override has been reviewed. Additional qualitative results based on a generalization of van Lookeren's theory are presented and compared to experiment. The scaling parameters presented in the literature for steam processes have been reviewed and compared to those arising from the proposed override theory. The first measurements of the characteristic time for decay of perturbations of a condensation front are presented and compared to theoretical values obtained for an infinite medium. The measured values are roughly 50 times longer than the predicted ones. Two possible reasons for this discrepancy are discussed. Grid quantization effects in the determination of the characteristic times for decay of perturbations of different wavelengths have been observed. 42 references, 8 figures.

0204 Processing

8279 **(NIPER—19-Vol.2) Processing and thermodynamics research, Volume II. Quarterly technical report, July 1-September 30, 1984.** (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). 4 Dec 1984. Contract FC01-83FE60149. 84p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85004364.

Volume II contains the following progress reports on processing and thermodynamics research: (1) thermodynamic properties of organic nitrogen compounds that occur in shale oil and heavy petroleum; (2) thermophysical and thermochemical properties of organic compounds derived from fossil substances; (3) stability and processing research for crudes, intermediate process streams, and finished fuels, (4) chemical characterization of heavy ends of light petroleum, of heavy petroleum, and of liquids derived from other fossil sources; (5) thermophysical properties of real and synthetic fluid mixtures derived from fossil substances; (6) fuel trends and analyses; and (7) chemistry of contaminated petroleum fuels.

8280 **(NP—5770049) Investigations on the hydropyrolysis of heavy oil and petroleum residues.** Schuetze, B. (Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Technische Fakultaet). 29 Jul 1982. 179p. (In German). NTIS (US Sales Only), PC A09/MF A01. File Number TI85770049.

In a continuous apparatus the charge oil is dispersed in superheated hydrogen in a spray reactor, exposed to the reaction conditions and subsequently examined in detail. The reaction gases are determined gas chromatographically and the liquid products characterised by distillation and by various physicochemical properties. In addition, a structural analysis of liquid products is carried out. In addition to material balances, and from these a calculation of H_2-consumption, a reaction hypothesis can be drawn up. Gas formation and aromatisation of liquid products increases with increasing degree of residue conversion. A top residue and Venezuelan heavy oil Jobo from the Orinoco tar sands were used as charge oil for hydropyrolysis.

8281 **(STF—15A83037) Optimization of crude heating train.** Loeken, P.A. (Sentralinstitutt for Industriell Forskning, Oslo (Norway)). Jan 1983. 55p. NTIS (US Sales Only), MF A01. File Number TI85750438.

A proposed crude heating train has been evaluated by the use of INTERHEAT computer program. The performed calculations show a payback time in the order of 3.76 years for the proposed process. This is reduced to 3.52 years with the use of modified boiler feed water flow rate specified by Rafinor. The proposed process was close to optimal in relation to crude temperature before the crude heater and for intermediate buffer cut temperature. The boiler feed water heating may be improved by utilizing available energy. This alternative process gives a payback time of 2.84 years. Added investment is calculated to 2.3 millions NOK including 0.5 mill. NOK for new piping between the site and the boiler house. This results in a reduced operation cost of. 3.9 mill NOK per year compared to the proposed process. The input cost data for this calculation are rather approximate at this stage of the evaluations. With better cost data more accurate optimizations may be performed. A process resilience analyses is performed as an example. This illustrate the complexity of this type of analysis.

0205 Products And By-products

REFER ALSO TO CITATION(S) 0205008452

0206 Health And Safety

REFER ALSO TO CITATION(S) 0206008265, 8333

8282 **(CONF-8109272—) Fire protection offshore. Seminar report.** Kaarstd, O. (Norges Teknisk-Naturvitenskapelige Forskningsraad, Oslo). 1981. 162p. NTIS (US Sales Only), PC A08/MF A01. File Number TI85750428.

From Safety offshore seminar on fire protection; Bryne, Norway (23 Sep 1981).

Fire and explosions have the potential to cause disasters in the offshore activity. A large number of people as well as a substantial accumulation of material values on top of huge hydrocarbon quantities in a severe environment are obvious reasons for caution. The fire and explosion projects sponsored by the Safety Offshore Research Programme were mainly started in late 1978 or early 1979. In the period up to the end of 1980, the Safety Offshore financed research within the three areas of fire, spreading of gases and gas explosions. Starting in 1981 the research on gas explosions will be financed in separate and substantial industry programmes and the Safety Offshore decided not to sponsor further research into gas spreading as well. At the same time it was decided that fire research should be given a higher priority and the industry become more involved in the financing and steering of these research efforts. The seminar was arranged with two main objectives. The first being to spread the results of the fire research to users in the various areas of the oil industry. A second objective was to get feedback from a wider range of users about the direction of the research. Separate abstracts were prepared for each paper presented at the seminar.

8283 (CONF-8109272—, pp 5-18) **Fires and explosions - causes and consequences.** Sofyanos, T.; Odgaard, E. (Det norske Veritas, Oslo (Norway)). 1981. NTIS (US Sales Only), PC A08/MF A01. File Number TI85750428.

From Safety offshore seminar on fire protection; Bryne, Norway (23 Sep 1981).

A statistical survey of fire and explosion accidents on offshore platforms in the U.S. Gulf of Mexico has been performed. Though the analysis has been based on a rather condensed description of each event, valuable information has been found regarding the causes of major accidents, the type of equipment frequently involved in accidents, the relation between material damage and severity for humans, the category of fire (e.g. gas fire, pool fire), etc.. 5 drawings, 5 tables.

8284 (CONF-8109272—, pp 25-43) **Study of turbulent flames.** Soenju, O. 1981. NTIS (US Sales Only), PC A08/MF A01. File Number TI85750428.

From Safety offshore seminar on fire protection; Bryne, Norway (23 Sep 1981).

The results of experimental work on turbulent diffusion flames for liquid and gaseous fuels released from straight tubes/pipes are discussed here. The main objective of the program is to obtain experimental data with a mixture of oil and gas and to try to obtain correlations and scaling laws for such flows regarding flame size and thermal radiation. No data of this type are available in the literature. In checking out the test stands and for comparison, gaseous fuel flames are also investigated. 14 drawings.

8285 (CONF-8109272—, pp 45-57) **Numerical calculations of flames in three dimensional space.** Berge, G.; Magnussen, B. (SINTEF, Trondheim (Norway)). 1981. NTIS (US Sales Only), PC A08/MF A01. File Number TI85750428.

From Safety offshore seminar on fire protection; Bryne, Norway (23 Sep 1981).

The basic feature of numerical methods as described here is that the space is divided into a number of space elements. Balance equations for mass, momentum, heat, turbulence kinetic energy, different species etc. are then put up for each of the space elements and solved for the total space volume considered. The subdivision of the space is made in such a way that the basic equations for flow, heat and mass transfer can be solved by finite=difference methods. The main advantage of such methods in relation to more empirical methods and formulas, are that they are more general and consequently appliable to much greater variety of conditions. These methods also make it possible to take into consideration complex physics. 8 drawings.

8286 (CONF-8109272—, pp 59-87) **Heat loads from accidental hydrocarbon fires.** Odgaard, E.; Solberg, D. (Det norske Veritas, Oslo (Norway)). 1981. NTIS (US Sales Only), PC A08/MF A01. File Number TI85750428.

From Safety offshore seminar on fire protection; Bryne, Norway (23 Sep 1981).

Convective and radiative heat fluxes associated with accidental hydrocabon fires on platforms are described for gas jet and pool fires occurring either in open-air or in compartments. A simple theoretical model has been applied for calculating the average gas temperature in a compartment 10x10x7 m large for three kinds of ventilation openings: A. One door open. B. One louvered wall and C. 2 ft and 1 ft height openings along the top and bottom of the walls, respectively, covering 50% of the compartment wall perimeter. 11 drawings, 3 tables.

8287 (CONF-8109272—, pp 89-109) **Thermal response of structures and process equipment exposed to hydrocarbon fire.** Borgnes, O.;Solberg, D. (Det norske Veritas, Oslo (Norway)). 1981. NTIS (US Sales Only), PC A08/MF A01. File Number TI85750428.

From Safety offshore seminar on fire protection; Bryne, Norway (23 Sep 1981).

The lecture consists of a summary of five reports published earlier from the Norske Veritas. The first one discusses temperature rise of insulated and uninsulated hydrocarbon process vessels and process piping during hydrocarbon fires. The second one debates temperature rise of partly filled insulated and uninsulated propane process vessels and crude oil separators during hydrocarbon fires. The third one confers effects of insulation faults and uneven distribution spray water on process vessel metal temperature during hydrocarbon fires. The fourth one treats the temperature response of water cooled hollow columns and beams during hydrocarbon fires and finally the last one discusses the black body view factor formulas and other formulas for calculation of radiative heat transfer. 13 drawings.

8288 **(DOE/BC/10353—4) Health and safety handbook for enhanced oil recovery. Final report.** Adams, G. (Mitre Corp., McLean, VA (USA). METREK Div.). Aug 1983. Contract AC19-80BC10353. 135p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85003878.

Because of the wide variety of chemicals and operating techniques used in enhanced oil recovery (EOR), health and safety concerns are most effectively examined by looking at each individual process. This handbook is meant to serve as a reference guide to be used by contractors engaged in or considering oil production by EOR techniques. As an introduction to employee health and safety, this first section lists the elements necessary to a safety program by discussing the hazards endemic to oil production as a whole. Section 2 emphasizes the hazards, specifically associated with the major EOR processes as well as precautions and controls to be considered in reducing risks during their use. Section 3 offers guidance in complying with Federal standards while Section 4 discusses state standards for those states that have their own health and safety programs. Section 5 provides information on recommended safety practices and procedures for oil field operations as proposed by the American Petroleum Institute. Appendices contain information that will assist contractors in understanding and complying with health and safety requirements. Appendix A provides safety check lists that the contractor can use to help ensure that all areas of concern have been addressed. Appendix B lists consulting services that provide safety information and Appendix C names offices that enforce Federal and state regulations. A glossary of terms commonly used in the oil industry appears in Appendix D.

0207 Marketing And Economics

REFER ALSO TO CITATION(S) 0207008298, 8307, 8709

8289 **(DOE/EIA—0109(84/09)) Petroleum Supply Monthly, September 1984.** (USDOE Energy Information Administration, Washington, DC). Nov 1984. 104p. NTIS, PC A06/MF A01; 1 - GPO; GPO Dep. File Number DE85003679.

This report contains detailed statistics on the supply and disposition of petroleum and petroleum products for September 1984. Information on crude oil, finished motor gasoline, distillate fuel oil, residual fuel oil, liquefied petroleum gases are included. Detailed statistics show production for the current month as well as the year-to-date. Data are also tabulated for the US Petroleum Administration for Defense (PAD) Districts which include field production, refinery production, imports, stock withdrawal or addition, unaccounted for crude, net receipts, crude losses, refinery inputs, exports, products supplied, and ending stocks. The focus article discusses EIA data series for crude oil imports, motor gasoline supplied, and distillate and residual fuel oil supplied, as well as crude oil production. A companion article, An Evaluation of Crude Oil Production Statistics beginning on page xvii compares crude oil production volumes reported in EIA's petroleum supply publications with those shown in state reports.

8290 **(DOE/EIA—0219(83)) International Energy Annual, 1983.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). Nov 1984. 108p. NTIS, PC A06/MF A01 - GPO; GPO Dep. File Number DE85004299.

This report presents current data and trends for production, consumption, stocks, imports, and exports for primary energy commodities in more than 190 countries, dependencies and areas of special sovereignty. Also included are prices on crude petroleum and petroleum products in selected countries. Data are included on:

total primary energy production; crude oil and natural gas liquids production; petroleum consumption, trade, and stocks; natural gas production, consumption, and trade; coal production, consumption, and trade; hydroelectric power production; nuclear electric power production; and oil, gas, and coal reserves. 31 tables.

8291 **(DOE/EIA—0347(83-84)) Indexes and estimates of domestic well drilling costs, 1983 and 1984.** Anderson, T.C.; Funk, V.T. (USDOE Energy Information Administration, Dallas, TX. Dallas Field Office). Dec 1984. 115p. NTIS, PC A06/MF A01; 1 - GPO; GPO Dep. File Number DE85004172.

This report presents estimated well drilling and completion costs and indexes for thirteen onshore geographical areas of the United States. Included are estimates for composite (all types) wells, oil wells, gas wells, and dry holes. Service wells were not included in composite well costs. The drilling costs presented are instantaneous costs. Instantaneous costs are the contracted or purchase costs of services and products when drilling operations were assumed to commence. Drilling cost estimates for the year 1984 reflect an overall upward trend from 1983, for all depths considered, for oil wells, gas wells and dry holes, reflecting an increasing demand for drilling rigs during this period. Oil well drilling costs during 1984 were estimated to increase by a low of 2.7% for 10,000-ft wells in South Louisiana to a high of 32.4% for 2500-ft wells in the Mid-Continent Area. Gas well drilling costs for 1984 were estimated to decrease 0.5% for 15,000 and 17,500-ft wells in the southeastern Area and increase 29.2% for 3750-ft wells in the Mid-Continent Area. Dry hole drilling costs for 1984 were estimated to decrease by 1.5% for 15,000-ft wells in South Texas, and increase by 29.6% for 1250- and 2500-ft wells in the Mid-Continent Area. The composite of all domestic well drilling costs (oil, gas, and dry) is estimated to be up from 1983 by a low of 3.5% for 15,000 and 17,500-ft wells to a high of 17.4% for 1250-ft wells. Individual cost and index tables are shown by geographical area, type of well and depth, along with a 7-year plot of the drilling costs for the most frequently drilled depth during 1983. There are five appendixes. 94 figures, 70 tables.

8292 **(DOE/EIA—0459) Impact of surveillance fields on crude oil production in the United States.** Wood, J.H.; Funk, V.T.; Sanders, J.S. (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). Nov 1984. 135p. NTIS, PC A07/MF A01 - GPO; GPO Dep. File Number DE85003539.

This report presents an analysis of crude oil production trends in the US and focuses on the declining production from old, large fields (surveillance fields). Oil fields in the Alaska North Slope and the federal offshore areas have furnished the substantial increases in crude oil production necessary to maintain a near constant rate of production for the US during the past few years. Total US production has varied less than 1% (plus or minus) since the end of 1979. Excluding the Alaska North Slope and federal offshore areas, the remaining US oil production has continued to decline despite accelerated drilling during the years of 1980 through 1982. The North Slope fields currently producing are the Prudhoe Bay and the Kuparuk River. Production from the Prudhoe Bay field is expected to maintain the current rate of about 555 million barrels of oil per year for the next few years. The Kuparuk River field began producing in 1981 and produced about 32 million barrels of oil in 1982. Oil production from federal offshore fields grew by 5 million barrels in 1981 and increased another 33 million barrels in 1982. Data for the federal offshore fields indicate another 35 million barrel increase in 1983, reaching an annual production of 350 million barrels. Some 1606 OLD surveillance fields accounted for almost 75% of the total US oil production in 1982. Without production from Prudhoe Bay, the remaining 1605 OLD surveillance fields experienced an annual composite production-decline rate of 6.8% for 1977 through 1979, and 4.1% for 1980 through 1982. Approximately 11% of the US oil production for 1982 came from 6315 NEW fields that began producing after 1973. OTHER fields account for the remainder of the production. This category includes old fields that did not qualify as surveillance fields, lease condensate extracted from the gas produced from oil and/or gas fields, and new fields where production is not available at the field level.

0208 Waste Management

REFER ALSO TO CITATION(S) 0208008185

8293 **(PB—85-103026/XAD) Proposed Sampling and Analytical Methodologies for Addition to Test Methods for Evaluating Solid Waste: Physical/Chemical Methods (SW-846, 2nd Edition).** (Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste). 1984. 595p. NTIS, PC A25/MF A01.

Proposed Sampling and Analytical Methodologies for Addition to 'Test Methods for Evaluating Solid Waste, Physical/Chemical Methods' (SW-846, 2nd Edition). A compilation of sampling and analysis methods is being proposed for addition to EPA's methods manual 'Test Methods for Evaluating Solid Waste, Physical/Chemical Methods'. Proposed analytical methods include various techniques to characterize samples of waste, ground water, and stack emissions for properties such as organic and inorganic content, corrosivity, radioactivity, and total oil and grease. Methods are also proposed for sampling ground water, incinerators and land treatment facilities.

8294 **(PB—85-103034/XAD) Risk assessment of waste oil burning in boilers and space heaters. Final report.** (PEDCo-Environmental, Inc., Cincinnati, OH (USA)). Aug 1984. 248p. NTIS, PC A11/MF A01.

As petroleum prices increased dramatically in the 1970's, the burning of used oils as supplemental fuel in boilers and space heaters became the most common recycling method for used oils. Congress, in passing the Used Oil Recycling Act, expressed the concern that the contaminants in used oil might be released as hazardous air pollutants as a result of burning used oil, and directed EPA to consider the need for regulations in this area. This report uses used oil composition data, combustion testing data, air dispersion modeling techniques, and pollutant health effects data to quantitatively assess the hazards that might result from burning used oils under certain situations.

0209 Environmental Aspects

REFER ALSO TO CITATION(S) 0209008294, 8333, 8680, 8953, 8954, 9042, 9065

8295 **(NHL—281122) Spreading of oil in coastal waters. Report No. 3. Current and oil spreading calculations for the area of outer Oslofjord.** Gjerp, S.A.; Lervik, E.; Oldervik, O.; Emblem, K. (Norges Hydrodynamiske Lab., Trondheim). Feb 1982. 70p. (In Norwegian). (STF—60A81122). NTIS (US Sales Only), PC A04/MF A01. File Number TI85750436.

The other two partial reports in this project are published earlier under the same main heading. The first one is dated the 8th of March 1979 and the second the 22nd of August 1980. In this report one model calculating the surface current and another which calculates the spreading of a proposed oil spill in the area are presented. The models are used for calculating the spreading of oil from an assumed spill at four different locations. The calculations are done for four current and wind situations (typical summer conditions, summer conditions with strong wind, winter conditions with storm and typical winter conditions). Drifting courses for the oil are stipulated every sixth hour. If the oil drifted ashore, then the time of and the place for the event is presented. 50 drawings, 14 tables.

8296 **(PB—84-245612) Method for ranking biological habitats in oil spill response planning and impact assessment.** Adams, J.K.; Benkert, K.A.; Keller, C.; White, R. (Fish and Wildlife Service, Slidell, LA (USA). National Coastal Ecosystems Team). Aug 1984. 51p. (FWS/OBS—82/61). NTIS, PC A04/MF A01.

Sponsored in part by LOOP, Inc., Harvey, LA. Library of Congress catalog card No. 84-601103.

The report describes a method that enables oil spill response planners to minimize the ecological impacts of oil spills by deter-

mining protection priorities for biological habitats. The objective of the method is to allow persons responding to an oil spill to quickly identify areas that should be protected first, second, and on to the extent that personnel and equipment are available. The first part of the report describes the rationale and general components of the method. The last part presents an application of the method to the Louisiana Offshore Oil Port (LOOP) spill response planning area.

8297 **(SI-R—820226-1) Statistical determination analysis for the strategies in Norwegian oil pollution containment. An analysis of the TKN project's risk model.** Seim, G. (Sentralinstitutt for Industriell Forskning, Oslo (Norway)). Jan 1983. 114p. (In Norwegian). NTIS (US Sales Only), PC A06/MF A01. File Number TI85750434.

Determination analysis is used for evaluating different types of states of coastal preparedness related to oil pollution containment. In this report a risk model is described. The model uncertainty related to uncertain model parameters is analysed. The uncertainty of various model results is estimated and how to determine uncertainty of other parameters based on the use of the risk model is demonstrated. The risk model is used to find the probability distribution of oil spills during a decade in order to demonstrate the threat oil spills represent to the coastline. The effect of various large oil spills is studied. Finally the report deals with the problem of selecting the necessary events in order to carry out the risk analysis. The parts of the project most closely associated with the risk model is also described. 37 drawings, 27 tables.

0210 Legislation And Regulation

8298 **Update on DOE's oil pricing regulations.** Barnes, G.H. *Annu Southwestern Legal Found Inst on Oil and Gas Law and Taxation Proc;* **32**: 267-299(1981). (CONF-8102106—).

From 32. annual Southwestern Legal Foundation Institute meeting on oil and gas law and taxation; Dallas, TX, USA (11 Feb 1981).

When crude oil price controls expire not later than September 30, 1981, domestic producers will have been under price controls for ca. 8 years. Although the expected termination of crude oil price controls is welcome and bodes well for the development of further domestic supplies of energy, the creation of a series of new regulatory concepts may signal a wave of new enforcement action and litigation. The adoption of final regulations, effective January 1, 1981, imposes upon producers the obligation to certify to DOE the basis upon which properties are certified as newly discovered, and imposing substantial and explicit record maintenance requirements on producers may be the first step in that process. Details of past and present regulations are presented.

0230 Properties

REFER ALSO TO CITATION(S) 0230008279

8299 **(AD-A—145483/4) Variability of major organic components in aircraft fuels. Volume 3. Sample data package for the reference JP-4 fuel. Interim report December 1982-November 1983.** Hughes, B.M.; Hess, G.G.; Simon, K.; Mazer, S.; Ross, W.D. (Monsanto Co., Dayton, OH (USA). Dayton Lab.). 27 Jun 1984. 84p. NTIS, PC A05/MF A01.

See also Volume 1, AD-A145 574.

This report summarizes qualitative and quantitative data on the chemical variability of approximately 300 features (chemical components or mixtures of components) with concentrations greater than 0.1 mg/ml in Air Force distillate fuels obtained from over 50 sources. These data were obtained to better understand the environmental effects of possible fuel spills and to serve as a data baseline in photochemical smog an soot formation studies. Fifty-four petroleum-derived JP-4 fuels, one shale-derived JP-4 fuel, and one petroleum-derived JP-5 fuel were analyzed.

8300 **(AD-A—145574/0) Variability of major organic components in aircraft fuels. Volume 1. Technical discussion. Interim report December 1982-November 1983.** Hughes, B.M.; Hess, G.G.; Simon, K.; Mazer, S.; Ross, W.D. (Monsanto Co., Dayton, OH (USA). Dayton Lab.). 27 Jun 1984. 76p. NTIS, PC A05/MF A01.

See also Volume 3, AD-A145 483.

This report summarizes qualitative and quantitative data on the chemical variability of approximately 300 features (chemical components or mixtures of components) with concentrations greater than 0.1 mg/ml in Air Force distillate fuels obtained from over 50 sources. These data were obtained to better understand the environmental effects of possible fuel spills and to serve as a data baseline in photochemical smog and soot formation studies. Fifty-four petroleum-derived JP-4 fuels, one shale-derived JP-4 fuel, and one petroleum-derived JP-5 fuel were analyzed. The variability of the absolute concentrations in mg/ml was assessed for each feature in the capillary GC/FID (gas chromatography/flame-ionization detection) analysis of the 54 fuels.

8301 **(AD-A—145754/8/XAD) Compound class quantitation of JP-5 jet fuels by high performance liquid chromatography/differential refractive index detection. Memorandum report June 1982-June 1983.** Sink, C.W.; Hardy, D.R.; Hazlett, R.N. (Naval Research Lab., Washington, DC (USA)). 13 Sep 1984. 22p. (NRL-MR—5407). NTIS, PC A02/MF A01.

Fuel composition effects are known to significantly affect jet turbine engine performance. Currently, one important composition parameter, total aromatics (% v/v), is actually defined in all JP-4 and JP-5 military fuel specifications governing procurement. This report outlines an improved method for defining not only total aromatics but also the two sub-classes, mono-cyclic and di-cyclic aromatics, that make up the total aromatics in JP-5. Special emphasis has been placed on the accurate and precise quantitation of saturates, mono-cyclic and di-cyclic aromatic fractions. This has been accomplished for fuels in the JP-5 distillation range by direct quantitation with a low sensitivity differential refractive index (DRI) detector. The detector is first calibrated by an appropriate standard and the response factors (= weight/area) for each compound class are used by a calculating electronic integrator/recorder to report directly each subsequently analyzed fuel in weight percent for each compound class. The analysis of each fuel is fast and very precise. Accuracy appears to be quite good and is under further investigation. Long term analytical stability has proven (up to one year). Quantitative data for thirteen JP-5 fuels have been compared with data from fluorescence indicator absorption, HPLC/GC (High Performance Liquid Chromatography/Gas Chromatography) and gravimetric data. The thirteen fuels include several experimental jet fuel blends and one shale JP-5 fuel.

8302 **(AD-A—145816/5/XAD) CRC (Coordinating Research Council, Inc.) octane number requirement survey, 1983.** (Coordinating Research Council, Inc., Atlanta, GA (USA)). Aug 1983. 242p. (CRC—539). NTIS, PC A11/MF A01.

In the 37th annual statistical survey of current model vehicles conducted by the Coordinating Research Council, Inc., test data were obtained on 383 1983 model vehicles, including 300 US vehicles and 83 imported vehicles. Fifteen laboratories participated in this Survey. Maximum octane number requirements were determined by testing under part-throttle conditions, as well as at maximum-throttle. Requirements are expressed as the Research octane number, Motor octane number, and (R+M)/2 octane number of the reference fuel which produced the least audible knock due to either spark or surface ignition, whichever was limiting. Estimated octane number requirements for the US vehicles are weighted in proportion to the 1983 vehicle model production figures and, for the imported models, in proportion to import sales volume in the United States.

8303 **(AD-A—145831/4/XAD) Variability of major organic components in aircraft fuels. Volume 2. Illustrations. Interim report December 1982-November 1983.** Hughes, B.M.; Hess, G.G.; Simon, K.; Mazer, S.; Ross, W.D. (Monsanto Co., Dayton, OH (USA). Dayton Lab.). 27 Jun 1984. 218p. NTIS, PC A10/MF A01.

See also Volume 1, AD-A145 574.

This report summarizes qualitative and quantitative data on the chemical variability of approximately 300 features (chemical components or mixtures of components) with concentrations greater than 0.1 mg/ml in Air Force distillate fuels obtained from over 50 sources. These data were obtained to better understand the environmental effects of possible fuel spills and to serve as a data baseline in photochemical smog and soot formation studies. Fifty-four petroleum-derived JP-4 fuels, one shale-derived JP-4 fuel, and one petroleum - derived JP-5 fuel were analyzed. The variability of the absolute concentrations in mg/ml was assessed for each feature in the capillary GC/FID (gas chromatography/flame ionization detection) analysis of the 54 fuels. Data base management programs developed and used in this assessment included the calculation of averages, ranges, standard deviations, and percent relative standard deviations of the 300 chromatographic feature concentrations in duplicate analyses of almost all of the fuels.

8304 **(AD-A—146360/3/XAD) Storage stability of jet fuels. Final report February 1983-August 1984.** Li, N.C. (Catholic Univ. of America, Washington, DC. Dept. of Chemistry). Aug 1984. 45p. NTIS, PC A03/MF A01.

Storage stabilities of jet fuels derived from petroleum were determined using laser light scattering, sediment formation, and oxygen uptake measurements. Fuel degradation was monitored in the presence of the following added specific compounds: 2,5-dimethylpyrrole (DMP), N-methyl pyrrole (NMP), thiophenol, thiophene, decanethiol, dibutyl sulfide, dibutyl disulfide, tetrahydrothiophene, hexadienes, 1-hexene, indene, and dimethyl quinoline (DMQ) and mixtures of these at various temperatures. The light scattering results are correlated with extent of deposit formation, which is an accepted measure of stability, and with oxygen uptake results.

8305 **(NP—5770044) Trace elements in petroleum, associated oil field waters and the kerogen fraction of selected drill core samples from the Alpine foreland (Southern Germany).** Ellrich, J. (Technische Univ. Muenchen (Germany, F.R.). Fakultaet fuer Chemie, Biologie und Geowissenschaften). 12 May 1982. 125p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number TI85770044.

The content of the elements S, Fe, V, Cr, Co, Ni, Zn, Se, Br, I, Ag and Hg was determined in 45 petroleum samples from 17 oil fields of 9 different mesozoic or tertiary reservoir horizons; the concentrations of S, V, Cr, Fe, Co, Ni, Zn, Se, I, Ag and Hg were determined in 23 selected kerogen samples from drill cores of upper carbon to aquitane; and Na, Mg, S, Cl, Ca, Co, Fe, Cu, Zn, Br, Sr and I determined in 15 underground water samples. Instrumental analysis (mainly INAA together with RFA, AAS and AES) and titrimetric procedures were the chief methods used.

8306 **(PB—85-100782/XAD) Study on the possibilities for the replacement of lead in gasoline by the addition of compounds. Final report.** (Commission of the European Communities, Luxembourg). [1984]. 123p. (EUR—8739-EN). NTIS, PC E06/MF E06.

A number of chemical compounds, including methanol, ethanol, the isomers of propanol and butanol, and methyl tertiary butyl ether (MTBE), have high octane numbers and can be added to gasoline to compensate for the effects of a reduction in the lead content. In Western Europe only methanol, tertiary butyl alcohol (TBA) and MTBE can be produced at a cost comparable to their value in the gasoline pool. Ethanol, and the normal and iso propanols and butanols cost more than twice their value, and their use would only be attractive if heavily subsidized.

0240 Storage

8307 **(GAO/RCED—84-61) Defense Fuel Supply Center procedures for purchasing Strategic Petroleum Reserve oil.** Bowsher, C.A. (General Accounting Office, Washington, DC (USA). Office of the Comptroller General). 21 Sep 1984. 48p. US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760. File Number TI85900505.

As one of a series of reviews on the Strategic Petroleum Reserve, GAO examined the procedures that the Defense Fuel Supply Center used to acquire about 130 million barrels of crude oil for the Reserve from February 1981 to May 1983. GAO found that the purchasing procedures generally assured that purchase prices were fair and reasonable and resulted in the lowest overall cost to the government. GAO found, however, that the Defense Fuel Supply Center could have paid about $1.9 million less during the period evaluated, and still acquired oil of acceptable quality, if it had been more flexible in its purchase practices by allowing exceptions to its pricing criteria. GAO recommends that the Defense Fuel Supply Center develop formal guidelines for making exceptions to its pricing criteria, including consideration of offers that slightly exceed the market high price but result in lower per barrel acquisition costs. 1 table.

8308 **(GAO/RCED—85-40) Status of Strategic Petroleum Reserve activities as of September 30, 1984.** (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 15 Oct 1984. 30p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760. File Number TI85900503.

The Department of Energy reported that 70.1 million barrels of oil were delivered to the Strategic Petroleum Reserve during fiscal year 1984, for an average annual fill rate of 192,000 barrels per day. As of September 30, 1984, the Reserve contained 431.1 million barrels. This report discusses the progress being made in filling, developing, and operating the Reserve. It also discusses other events and activities affecting the Reserve that occurred during the fourth quarter of fiscal year 1984. 1 figure, 10 tables.

8309 **(PB—85-104289/XAD) Problems in connection with storage of heavy fuel oil. I. Description of the problems.** Roffey, R.; Hjalmarsson, K. (Foersvarets Forskningsanstalt, Umea (Sweden)). [1984]. 36p. (In Swedish). (FOA-C—40196-B4). NTIS, PC E04/MF E01.

During recent years oil powered energy production has been used to a lesser extent in Sweden which has meant that heavy fuel oils have been stored for longer periods in rock caverns. In a few cases problems have been observed with sludge, deposition of wax, growth of emulsions layers, increase in water content, corrosion and microbial methane production in caverns. The stability of stored heavy fuel oils is briefly presented. Changes during storage for long periods are discussed. The role of microorganisms in the processes causing the observed problems is presented.

8310 **(SAND—84-1598) Estimating recoverable oil volume remaining in Weeks Island as a function of pump rate at the time of pump cavitation.** Tomasko, D. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1984. Contract AC04-76DP00789. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004105.

The recoverable volume of crude oil in Weeks Island at the time of pump cavitation is estimated to be approximately 1% of the initial oil inventory. Even though uncertainties in the calculational model are large, the final result is expected to be within a factor of 2 or 3 of the actual value. 9 references, 3 figures, 1 table.

0250 Combustion

REFER ALSO TO CITATION(S) 0250008243, 8790

03 NATURAL GAS

REFER ALSO TO CITATION(S) 0300008261

0301 Reserves

REFER ALSO TO CITATION(S) 0301008328

0302 Geology And Exploration

REFER ALSO TO CITATION(S) 0302008220, 9118

8311 (DOE/METC—84-9) **Workshop on remote sensing/lineament applications for energy extraction.** Howard, J.F.; Komar, C.A.; Cooper, L.M. (eds.). (Howard Associates, Inc., Owensboro, KY (USA)). Apr 1984. 74p. (CONF-831240—). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE84009291.

From Workshop on remote sensing/lineament applications for energy extraction; Morgantown, WV, USA (2 Dec 1983).

The following six papers are presented in this proceedings: (1) lineaments - a look forward and backward; (2) remote sensing/lineament analysis applications workshop - a general summary; (3) geologic controls on lineament systems, Pike County, Kentucky; (4) air-photo lineament domains in a portion of the Appalachian Basin - an application for exploration; (5) subsurface anomalies expressed as lineaments in the Northwest Pennsylvania portion of the Appalachian Plateau; and (6) effect of short lineaments on gas well yield from Devonian shales in Eastern Kentucky. All papers have been processed for inclusion in the Energy Data Base.

8312 (DOE/METC—84-9, pp 7-10) **Remote sensing/lineament analysis applications workshop: a general summary.** Howard, J.F. Apr 1984. NTIS, PC A04/MF A01. File Number DE84009291.

In Workshop on remote sensing/lineament applications for energy extraction.

The purpose of this conference was to provide a forum for a group of private consultants who have been involved in the field as practicing agents for up to 30 years and who represent the state-of-the-art in applications of the technique. Emphasis of the workshop was not placed upon the technique of lineament identification, but rather on the potential uses of the systems as effective supplements to the traditional methods of geologic exploration, evaluation and development of natural resources. Significant aspects of lineament analysis and interpretation presented during the workshop are summarized in general in the following discussions: (1) effectiveness of techniques for identification; (2) geologic interpretations; and (3) physical characteristics of lineaments. It was pointed out that effective utilization of the systems in the exploration and development package must involve the following elements: (1) identification and marking of the lineament systems by experienced personnel; (2) field ground-truthing of the lineament features utilizing geomorphic or geophysical evidence; (3) statistical treatment to establish directions of dominant and secondary elements; (4) comparison of all data with known production (in fluid production applications) or mine problems (in mine planning); (5) comparison of data with regional (and local) geologic/tectonic framework to the extent possible with available data; and (6) actual site inspection and site selection of drilling sites by personnel in the field utilizing imagery from which data was derived.

8313 (DOE/METC—84-9, pp 11-36) **Geologic controls on lineament systems, Pike County, Kentucky.** Taylor, M.L.; Howard, J.F. Apr 1984. NTIS, PC A04/MF A01. File Number DE84009291.

In Workshop on remote sensing/lineament applications for energy extraction.

An area of 237 square miles covering the Millard Lick Creek, Elkhorn City and Hellier quadrangles in eastern Kentucky has been subjected to lineament analysis. Lineaments for the area were compiled utilizing 1:250,000 scale, band 5 landsat, 1:82,000 scale, quad-centered and 1:24,000 scale, black and white imagery. Integration of data on orientation, density and lengths of lineaments indicate distinct relationships with tectonic trends associated with the Pine Mountain and Russell Fork faults at the landsat and intermediate scales. Low level lineaments exhibit distinct clustering phenomena and an extremely high average density of greater than 40 lineaments per square mile. Orientations and contours of low-level features indicate a general correlation with regional tectonic patterns with modifications due to small scale structural features. It is probable that the clustering phenomenon is due to the small scale, rather than regional tectonic effects. Variations in overall density of low level features appear to be correlated with two basic mechanisms. (1) Torsional stress imposed by the proximity of the eastern margin of the Pine Mountain Thrust Fault. (2) Relief of local stress affecting low-level lineaments by tear faulting, e.g. the Russell Fork Fault. 18 references, 18 figures, 2 tables.

8314 (DOE/METC—84-9, pp 37-52) **Air-photo lineament domains in a portion of the Appalachian Basin: an application for exploration.** Wellendorf, W.G.; Gardner, J.V. (Mars Associates, Inc., Phoenix, AZ). Apr 1984. NTIS, PC A04/MF A01. File Number DE84009291.

In Workshop on remote sensing/lineament applications for energy extraction.

Lineaments interpreted from aerial photography at a scale of 1:80,000 were registered to eight 7.5' topographic maps in a portion of northern West Virginia. Cumulative length versus azimuth orientation diagrams were constructed from the digitized lineament data. These were used to locate and identify significantly concentrated photolineament sets. These sets may exhibit specific genetic relationships to the geologic - in particular the areal extent of the Burning Springs structure. Various statistical techniques were utilized to observe changes or similarities in the areal distribution of lineament populations. Furthermore, computer mapping and analysis procedures were used in an attempt to locate precisely where certain parameters of the lineament populations exhibited a change in angular distribution or defined a different photo lineament domain. These changes in photo lineament domains can help the explorationist establish models and to develop a rationale for exploiting areas which are influenced by subtle structural changes. 13 references, 9 figures.

8315 (DOE/METC—84-9, pp 53-62) **Subsurface anomalies expressed as lineaments in the Northwest Pennsylvania portion of the Appalachian Plateau.** Pees, S.T. (Samuel T. Pees & Associates, Meadville, PA). Apr 1984. NTIS, PC A04/MF A01. File Number DE84009291.

In Workshop on remote sensing/lineament applications for energy extraction.

Various Landsat images and return-beam vidicon scenes were used to locate 24 lineaments in Erie County, Pennsylvania. The vectors of the dominant set average 329° with the azimuth range being NNW to NW. The dominant set are cross-strike lineaments and some correspond closely to dip reversals on structural maps of deep formations. The secondary set of Landsat lineaments average 49° and often coincide with the approximate NE strike of the mapped beds. Along-strike lineaments are usually not reflected by conspicuous anomalous configurations of the structural contours, at least not in a consistent way along the path of the lineament.

8316 (DOE/METC—84-9, pp 63-72) **Effect of short lineaments on gas well yield from Devonian shales in eastern Kentucky.** Rauch, H.W.; Narotzky, K.G.; Ragan, J.; Newton, D.J. (West Virginia Univ., Morgantown; Getty Oil Co., New Orleans, LA; Texaco USA, New Orleans, LA). Apr 1984. NTIS, PC A04/MF A01. File Number DE84009291.

In Workshop on remote sensing/lineament applications for energy extraction.

Investigations, regarding the associations of lineaments with gas well yield from Devonian shales, have been undertaken in three separate studies for portions of Martins, Johnson, and Lawrence counties in eastern Kentucky. Short lineaments were defined and mapped as photolineaments and curvilineaments. Photolineaments are topographic features usually representing straight stream or

valley segments at least 0.5 km long, and curvilineaments represent uniformly curved streams or valleys at least 0.5 km long. Useful gas exploration trends were discovered after testing for relationships between gas yield and nearby lineaments by graphical and statistical means. Gas well yield is noticeably higher within about 0.5 to 1.0 km of a photolineament, and especially high within 0.04 to 0.05 km of a photolineament. The optimum photolineaments for gas wells are oriented approximately east-west or east-north-east; wells near such lineaments yield at rates about double those for average Devonian shale wells. The optimum length for photolineaments appears to be about 1.5 km (roughly 1 mi), for best gas yields. Curvilineaments show no strong trends with gas well yield, and are probably not useful in gas exploration. In summary, selective use of short lineaments is recommended for optimum results in shallow gas exploration in the Appalachians, after careful site studies are made. 8 references, 8 figures.

8317 **Exploration/production studies of the Devonian gas shales.** McBane, R.A.; Thompson, T.W. (Gas Research Inst.). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE/DOE/GRI 12833**: 29-36(May 1984). (CONF-8405120—).

From SPE/DOE/GRI unconventional gas recovery symposium; Pittsburgh, PA, USA (13 May 1984).

Producers currently develop Devonian shale gas fields by drilling wells which offset a high productivity well. Remote sensing as well as various geophysical and geochemical techniques are sometimes used to site wells. Yet, productivity of the development wells can be highly variable. In an attempt to improve the production potential of these wells, the Gas Research Institute has undertaken a research program aimed at developing a better understanding of the geological features which control production in the shale, and which a wellbore must intersect or communicate with in order to result in higher productivity. A better understanding of these geological production controls is necessary to develop an exploration or stimulation methodology which will enable the producer to better locate and stimulate wells, and thus improve overall productivity of the field.

8318 **Geological and production characteristics of the nonmarine part of the Mesaverde Group, Rulison Field area, Piceance Basin, CO.** Peterson, R.E. (CER Corp.). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE/DOE/GRI 12835**: 47-56(May 1984). (CONF-8405120—).

From SPE/DOE/GRI unconventional gas recovery symposium; Pittsburgh, PA, USA (13 May 1984).

Trends of subsurface structure, total sandstone isopachs and thickness variations are used to geologically characterize the depositional subdivisions of the non-marine part of the Mesaverde Group in the Rulison Field area of the southern Piceance Basin. Investigation of a gas production trend indicates that higher productivity may be controlled by structure induced fracturing and is independent of thicker sandstone accumulations. In addition, overpressured gas reservoirs in a non-marine part of the Mesaverde Group have not been fully evaluated and may be an important exploration target.

8319 **Porosity and permeability of tight sands.** Randolph, P.L.; Chowdiah, P.; Soeder, D.J. (Inst. of Gas Technology). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE/DOE/GRI 12836**: 57-66(May 1984). (CONF-8405120—).

From SPE/DOE/GRI unconventional gas recovery symposium; Pittsburgh, PA, USA (13 May 1984).

Detailed analyses of more than 50 core samples of western tight sands have resulted in several unanticipated observations that are set forth in this paper. Core analyses performed under stress representative of producing conditions provided data on porosity, pore volume compressibility, stress dependence of permeability to gas, and slope of the Klinkenberg plot (permeability at constant net stress vs. the inverse of pore pressure). Scanning electron microscope (SEM) and petrographic microscope analyses were performed on samples cut from the ends of core plugs tested. The microscopic studies were explicitly directed toward observing the <0.1 micron flow path openings deduced from permeability data. The Computer Operated Rock Analysis Laboratory (C.O.R.A.L.) used for these measurements has been previously described. Permeabilities are measured with a maximum pressure drop of 20 psi, much less than the pore pressure of 100 to 1500 psia. At the one microdarcy level, the standard deviation of a sequence of permeability measurements under constant conditions is typically 2% of the measured value. Resolution is a few nanodarcies. The accuracy of porosity measurement is about + or - 2% of the reported value, but the sensitivity to pore volume change due to an incremental step in confining pressure is better than 0.1% of the pore volume. Thus, pore volume compressibility is measured to an accuracy of a few percent for a 1000 psi step in confining pressure. The selection of tight sandstone samples for analysis involved an intentional bias. Namely, all samples were from depths that were either known to be gas producers or judged likely to be producers on the basis of wireline log analysis.

8320 **A systematic approach for the effective log analysis of tight gas sands.** Kukal, G.C. (CER Corp.). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE/DOE/GRI 12851**: 209-220(May 1984). (CONF-8405120—).

From SPE/DOE/GRI unconventional gas recovery symposium; Pittsburgh, PA, USA (13 May 1984).

A new log interpretation system called TITEGAS has been developed to analyze the reservoir characteristics and producibility of tight gas sands. The system is based upon equations which define the response of conventional logging tools. A basic log suite of density, neutron, and resistivity are the only logs required by the system, however TITEGAS also allows for utilization of various other logs including photoelectric effect, spectral natural gamma, micro-resistivity, microwave travel time, dielectric constant and acoustic travel time.

8321 **The multiwell experiment core program, II.** Sattler, A.R. (Sandia National Laboratories). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE/DOE/GRI 12854**: 235-244(May 1984). (CONF-8405120—).

From SPE/DOE/GRI unconventional gas recovery symposium; Pittsburgh, PA, USA (13 May 1984).

An unprecedented core analysis program is under way as part of DOE's Multi-Well Experiment (MWX). MWX is a research-oriented field laboratory whose objectives are to thoroughly characterize lenticular tight gas sands and to develop technology for their production. Over 4100 ft (1250 m) of core were taken from three wells separated by only about 115-215 ft (35-66 m) at depth. All major categories of core analysis are reviewed and results through December 1983 are included. Those include routine core analysis, restored state reservoir parameter measurements, electrical measurements, mechanical rock property data, mineralogy, organic maturation, natural fractures, and geochemistry. This paper also describes the laboratory work on core and formation invasion and the development of instruments that were used in the field processing of the core.

8322 **Stress ratio and stress trajectory simulations for Devonian gas shales.** Advani, S.H.; Andrews, A.; Komar, C.A.; Lee, J.K. (Ohio State Univ.). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE/DOE/GRI 12860**: 289-298(May 1984). (CONF-8405120—).

From SPE/DOE/GRI unconventional gas recovery symposium; Pittsburgh, PA, USA (13 May 1984).

A brief review of selected in situ stress studies is presented. Pertinent geomechanical factors and rationale for stress trajectory characterizations are discussed in the context of natural fracturing in geological formations. Examples with structural cross sections incorporating the influence of the Rome Trough are identified and potential mechanisms for in situ stress reorientation and tectonic relief across selected regions in the Appalachian Plateau Province in West Virginia are given. Detailed finite element stress simulations and stress ratios associated with cross sections through Southeastern Kanawha County extending from the Warfield anticline to the Cabin Creek syncline are also reported. A discussion of these

results and their correlation with available data and salient structural features is also given. In addition, the role of stress ratios, using a compressive-shear failure criterion, is emphasized in relation to the natural fracture systems in the Devonian shales.

8323 **A case study for exploration and development of the Trenton reservoir in Northwest Ohio.** Schrider, L.A.; Caprarotta, D.W.; Natoli, M.A.; Sawyer, W.K. (Belden and Blake Corp.). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE/DOE/GRI 12863**: 311-322(May 1984). (CONF-8405120—).

From SPE/DOE/GRI unconventional gas recovery symposium; Pittsburgh, PA, USA (13 May 1984).

Independent oil and gas companies such as Belden and Blake continue to search for new sources of hydrocarbon reserves. In many instances this has resulted in a re-evaluation of reservoirs that were considered depleted or of higher risk. The Trenton Limestone reservoir, located in the northwestern part of Ohio, is a case study of such an occurrence. Through an extensive three-year evaluation of this area, both geologically and from an active drilling program, it was found that the area still contains vast amounts of hydrocarbons located in various types of geologic traps. While large amounts of oil and gas exist in this reservoir, ultimate production is sensitive to well completion and production practices. More specifically in the case of natural gas, pressure transient tests were conducted to determine whether gas reserves were sufficient to consider pipeline construction. Results of the reservoir tests verified the Trenton formation to be of low permeability in the range of one millidarcy, and porosity between 2 and 4 percent. An economic evaluation was then performed to determine what reservoir flow capacities, well spacing and economic criteria were required for successful engineering and economic development. Conclusions of the case study showed (1) the need for high grading the well site selection through geological interpretation in order to expand the "sweet spots," (2) a need for stimulation treatments designed to enhance production, (3) a marginal return on investment with current economics, and (4) that gas pipeline construction should be delayed until larger reserves are found or until a more favorable gas marketing climate develops.

8324 **Interference testing of the naturally fractured Cozzette sandstone: A case study at the DOE MWX site.** Branagan, P.; Cotner, G.; Lee, S.J. (CER Corp.). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE/DOE/GRI 12869**: 359-366(May 1984). (CONF-8405120—).

From SPE/DOE/GRI unconventional gas recovery symposium; Pittsburgh, PA, USA (13 May 1984).

The DOE Multi-Well Experiment (MWX) is a research oriented field laboratory whose objective is to improve the technology and provide additional insight into the processes required to develop low permeability lenticular gas sandstone reservoirs. The site of the MWX is located in the Rulison Field in the Piceance Basin of Colorado. The MWX consists of three closely spaced wells drilled through the Marine Mesaverde Formation to depths of about 8,000 ft. A detailed geological and geophysical assessment is a continuous effort being conducted throughout the Piceance Basin and other areas as a means to characterize the salient features of this site. Very extensive core and logging programs were carried out in all three MWX wells with emphasis on the zones of interest. Seismic surveys and sedimentological investigations were conducted to provide an assessment of morphology, areal extent of lenses and others. As a prelude to the intensive reservoir investigations that were scheduled for the lenticular sandstones, several well tests were performed in the blanket Cozzette sandstone.

0303 Drilling, Production, And Processing

REFER ALSO TO CITATION(S) 0303008265, 8273

8325 **Porosity, permeability, and pore structure of the tight Mesa Verde sandstone, Piceance Basin, CO.** Soeder, D.J.; Randolph, P.L. (Inst. of Gas Tech.). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE13134**: 9(Sep 1984). (CONF-8409104—).

From 59. annual Society of Petroleum Engineers of AIME technical conference; Houston, TX, USA (16 Sep 1984).

Special core analyses on 44 tight Mesa Verde sandstone samples from the U.S. DOE Multiwell Experiment were combined with petrographic investigations in an attempt to relate the porosity and permeability of the cores to the pore structure of the rocks. Core analysis was performed on one inch (2.54 cm) diameter horizontal plug samples using a computerized steady-state flow measuring device. This equipment routinely measures flow rates with a resolution of better than 10^{-6} cm^3/sec. All samples were selected from intervals expected to be gas productive on the basis of wireline well logs, and were taken from the portion of the interval that showed the lowest gamma ray log response. The core plugs were measured for dry permeability to gas, relative permeability at various water saturations, porosity to gas, and pore volume compressibility. Petrographic samples were taken directly off the plug ends and were analyzed with both an optical microscope and a scanning electron microscope. The petrographic study was explicitly directed toward observing the flow paths and pore structure that had been deduced from the core analysis data. Petrographic observations revealed that the pore geometry of sandstone can be broken down into three categories: grain-supported pores, solution pores connected by narrow intergranular slots (the most common pore structure in the Mesa Verde) and matrix supported grains. Core analysis measurements correlated fairly well with pore geometry. Solution pores connected by slots varied by a factor of two in porosity and pore volume compressibility; the dry permeability values fell within the range of 0.1 to 10.0 microdarcies. Calculation of slot-like flow path dimensions from the permeability data revealed a characteristic width of only about 0.1 micron. Special core analysis of the Mesa Verde also showed trends that correlated with various depositional environments in the formation.

8326 **An ultrasonic borehole flowmeter for production characterization of Eastern Shale Gas reservoir.** Semmens, M.G.; Ondrik, M.A.; Tausch, H.J. (The BDM Corp.). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE/DOE/GRI 12849**: 195-200(May 1984). (CONF-8405120—).

From SPE/DOE/GRI unconventional gas recovery symposium; Pittsburgh, PA, USA (13 May 1984).

A gas borehole flowmeter providing high resolution flow measurement is being developed to support natural gas production enhancement research within the United States Eastern Devonian Shale. The flowmeter utilizes ultrasonic technology which will provide excellent resolution and measurement accuracy. Early developmental test data indicate that the tool will be able to measure very low flow rates produced by borehole gas entry before fracture, i.e., .009 dm^3/s (0.02 cfm). The use of time-of-flight dual transceivers will provide accurate gas velocity and flow measurements previously unavailable.

8327 **Pressure core measurements in tight sandstone lenses during the multiwell experiment.** Sattler, A.R.; Clark, J.A.; Heckes, A.A. (Sandia National Laboratories). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE/DOE/GRI 12853**: 229-234(May 1984). (CONF-8405120—).

From SPE/DOE/GRI unconventional gas recovery symposium; Pittsburgh, PA, USA (13 May 1984).

A pressure coring operation was performed in two tight sandstone lenses of the Mesaverde group during the drilling of one well of DOE's Multi-Well Experiment. The goals were: (1) to obtain accurate water saturation data; (2) to measure the amount and composition of gas on a foot-by-foot basis; and (3) to recover

fluids for water chemistry analysis. This application of pressure coring had not been tried before; it was felt to be the best approach for accurate water saturation measurements in tight sandstone core. Several changes to usual pressure coring procedures were adopted. These included the development of an organic noninvasive coring fluid, compatible with the oil-based drilling fluid used, that would help preserve water saturation. Three 15-ft pressure core barrels were taken in two sandstone lenses 20 and 30 ft thick; all three barrels were filled with sandstone. Goals 1 and 2 were met. Water saturation values are reported and discussed. The type and duration of the water extraction processes are shown to be very important in determining water saturations in tight sands. Gas species and amount are available on a foot-by-foot basis.

8328 **Tight gas resource and technology appraisal: Sensitivity analyses of the national petroleum council estimates.** Brashear, J.P.; Mercer, J.; Rosenbery, J.I. (Lewin and Assocs., Inc.). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE/DOE/GRI 12862**: 299-310(May 1984). (CONF-8405120—).

From SPE/DOE/GRI unconventional gas recovery symposium; Pittsburgh, PA, USA (13 May 1984).

In 1980, the National Petroleum Council (NPC) published the most authoritative and comprehensive estimates to date of the technical and economic potential of tight sands gas. While the NPC study remains the landmark effort on this subject, its estimates for recoverable natural gas are considered by many to be optimistic. The Gas Research Institute (GRI) and the Department of Energy (DOE) jointly commissioned construction of the Tight Gas Analysis System (TGAS) as a vehicle to perform systematic sensitivity analyses of the NPC study, to serve as a repository for future additions to the data base and analytical understandings of the technology, and to estimate the benefits of specified R & D advances. This paper describes TGAS briefly, demonstrates its reconciliation with published NPC results, and reports sensitivity analyses of: Improved fracture effectiveness with and without closer well spacing; Producing from gas-bearing lenses encountered by the wellbore versus lenses lying remote from the wellbore; and Altering the NPC's assumptions about the relationship between reservoir permeability and thickness. The reconciliation and sensitivity studies confirm the analytical integrity of the NPC study but also point out that the NPC's results contain significant uncertainties.

8329 **Practical methods for detecting production mechanisms in tight gas reservoirs.** Ammer, J.R.; Drophin, M.J.; Sawyer, W.K. (US Dept. of Energy). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE/DOE/GRI 12864**: 323-330(May 1984). (CONF-8405120—).

From SPE/DOE/GRI unconventional gas recovery symposium; Pittsburgh, PA, USA (13 May 1984).

A recent study has been conducted on the "Clinton" sandstone of Ohio by the U.S. Department of Energy. The purpose of the study was to identify production mechanisms as related to the geometry of the "Clinton" sandstone. The theory behind the study was that a log-log plot of cumulative production versus time is indicative of the flow behavior in the reservoir. A 0.50 slope would indicate linear flow exists while a slope of about 0.90 would indicate radial flow exists. Data from 284 producing "Clinton" gas wells from six counties in eastern Ohio were used in this study. Log-log plots of cumulative production versus time were generated and then the slope values were contoured so that a comparison could be made with regional geological parameters. The results of the study showed that the production mechanisms in the four regions are causing a linear to "intermediate" (between linear and radial) flow. Radial flow was exhibited in wells where the "Red Clinton" was better defined on the gamma ray log, suggesting an offshore bar or shoal. Linear flow was exhibited in wells where the "White Clinton" was more well developed suggesting channel or distributary bars. The intent of this paper is to make available to industry a practical approach to analyze the performance of past production. This knowledge can be used to gain insight to the factors affecting recovery so that an approach to improvements can be made.

8330 **Test of secondary gas recovery by coproduction of gas and water from Mt. Selman Field, TX.** Rogers, L.A. (Gas Research Inst.). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE/DOE/GRI 12865**: 331-340(May 1984). (CONF-8405120—).

From SPE/DOE/GRI unconventional gas recovery symposium; Pittsburgh, PA, USA (13 May 1984).

A previously watered-out and abandoned gas reservoir in the Sub-Clarksville formation of the Mt. Selman field in Northeast Texas was reentered and secondary gas recovery initiated by pumping of water. Pumping was done with a sucker rod pump and bottom hole pressures in the producing well and a nearby observation well was measured via gas filled capillary size tube extending into open ended larger tubing downhole. Numerical modeling to match past performance and project possible future production was done before and during the field test to compare theoretical and actual production results. A series of draw-down and build up tests over a three month period were performed to evaluate the reservoir and determine its potential for secondary gas recovery. No residual gas cap of mobile free gas was found. The remaining free gas was apparently trapped as an immobile dispersed phase within the reservoir rock matrix. The amount of gas dissolved in the reservoir brine was about 7 Scf/Stb (1.28 std m^3/m^3). The produced gas/brine ratio varied from 7 to 25 Scf/Stb (1.28 std m^3/m^3 - 4.5 std m^3/m^3) indicating that some immobile gas was mobilized by pumping water to lower the reservoir pressure. Gas analysis has shown the trapped free gas to be richer in heavier hydrocarbons than the dissolved gas.

0305 Health And Safety

REFER ALSO TO CITATION(S) 0305008265, 8282, 8283, 8284, 8285, 8286, 8287, 8333, 8952

8331 **(FNAL-TM—1163) Oxygen deficiency hazards associated with liquefied gas systems development of a program of controls.** Miller, T.M.; Mazur, P.O. (Fermi National Accelerator Lab., Batavia, IL (USA)). Jan 1983. Contract AC02-76CH03000. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004264.

The use of liquefied gases in industry and research has become commonplace. Release into the atmosphere of these gases, whether intentional or not, will result in a displacement of air and a reduction in the oxygen concentration. Exposure to reduced levels of oxygen levels may cause reduced abilities, unconsciousness, or death. This paper describes the derivation of a novel program of controls for oxygen deficiency hazards. The key to this approach is a quantitative assessment of risk for each planned operation and the application of control measures to reduce that risk to an acceptable level. Five risk levels evolve which are based on the probability of fatality. Controls such as training, oxygen monitoring equipment, self-rescue respirators, and medical surveillance are required when the probability of fatality exceeds 10^{-7} per hour. The quantitative nature of this program ensures an appropriate level of control without undue burden or expense. 11 references, 5 figures, 3 tables.

0306 Marketing And Economics

REFER ALSO TO CITATION(S) 0306008290, 8291, 8709

8332 **(DOE/EIA—0131(83)P/2) Preliminary data report: average price of natural gas delivered to consumers, 1983.** Koelling, G.W.; McDonald, M.R. (USDOE Energy Information Administration, Washington, DC). 12 Dec 1984. 14p. NTIS, PC A02/MF A01; 1 - GPO; GPO Dep. File Number DE85004891.

A preliminary compilation of the data indicates that the price of natural gas delivered to consumers in the United States during calendar year 1983 averaged $4.91 per thousand cubic feet (Mcf) on a volume weighted basis. This was 14 percent higher than in 1982 and 148 percent more than during 1978, the year in which the Natural Gas Policy Act (NGPA) was enacted. The escalation in consumer prices since 1978 occurred in conjunction with an in-

crease of 185 percent in average annual wellhead prices, a 139 percent higher average annual import price, and rising transmission and distribution costs. Annual growth in the average price of natural gas delivered to consumers during the 1978 to 1983 period was lowest in 1983 when the rate of increase in average annual wellhead price declined to 5 percent and the average annual import price was 14 percent below the record high level of 1981. These preliminary data, which are not expected to vary significantly from final 1983 data, show that residential prices increased 137 percent between 1978 and 1983. Increases for commercial, industrial, and electric utility consumers for the same period were 152 percent, 166 percent, and 142 percent, respectively. The average price of gas delivered to both residential and industrial consumers increased 17 percent between 1982 and 1983, and residential consumers paid the highest average price, $6.06 per thousand cubic feet, in 1983. The average price of commercial and electric utility deliveries increased 16 percent and 3 percent, respectively, over 1982 prices. 7 figures, 2 tables.

0307 Waste Management

REFER ALSO TO CITATION(S) 0307008185

0308 Environmental Effects

8333 **(DOE/EP/16008—T1) Hydrocarbon pool and vapor fire data analysis.** Mudan, K.S. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Oct 1984. Contract AC01-83EP16008. 110p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85005084.

The flame geometry and thermal radiation data from a series of large scale experiments involving liquefied petroleum gas (LPG) and gasoline spills on water were analyzed. The experiments were conducted at the Naval Weapons Center, China Lake, California. Two types of fires have been studied; namely, pool fires and vapor fires. The spill quantity varied from 4 m^3 to approximately 6 m^3. The LPG pool fire flame height to diameter ratio were between 3.5 and 4.5. The gasoline flame height was about 2. The flame emissive powers for LPG pool fires ranged from 78 kW/m^2 to 115 kW/m^2. The average surface emissive power for gasoline pool fire was 40 kW/m^2. The LPG vapor fire emissive power ranged from 159 to 269 kW/m^2. 63 figures, 13 tables.

0309 Artificial Stimulation

8334 **(DOE/MC/11047—T2) Conceptual design of a wireline hydraulic fracturing tool.** (Terra Tek, Inc., Salt Lake City, UT (USA)). Jan 1980. Contract AC21-79MC11047. 137p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE84015216.

This research indicates that knowledge of in situ stress fields offers the key to better design of fracture treatments and control of fracture growth. Techniques for measurement of in situ stress variation within a gas reservoir must be developed into a routine test that is both economic and acceptable to well operators before significant advances in fracturing treatment design technology can be made. Pertinent in situ material properties normally can be obtained with some degree of precision through the use of geophysical logs supplemented by a lab testing program. In situ stress measurements on the other hand are difficult to obtain and presently only one technique, hydraulic fracturing, can be used to obtain this data at depths greater than about 200 meters. This report describes a research program that is in the initial stages of designing and evaluating the use of wireline tools for measuring in situ stress by hydraulic fracturing. The use of wireline tools could significantly reduce the cost of these stress measurements by drastically reducing the test preparation time required to set high pressure tubing to the required depth. Additionally, the research program is evaluating the possibility of measuring in situ stresses through perforated casing. A laboratory program of simulated in situ stresses, casing and cementing will attempt to demonstrate the feasibility of such measurements. The combination of reduced test time through the use of wireline tools and minimal well damage by fracturing through perforated casing should allow hydraulic fracturing measurements to be made on a routine basis in almost all exploratory wells. 30 references, 37 figures, 3 tables.

8335 **Methane production characteristics for a deeply buried coalbed reservoir in the San Juan Basin.** Jones, A.H.; Ahmed, U.; Bell, G.J.; Bowman, K.C.; Bush, D.D.; Holland, M.T.; Kelkar, S.M.; Rakop, K.C. (Terra Tek Inc.). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE/DOE/GRI 12876**: 417-432(May 1984). (CONF-8405120—).

From SPE/DOE/GRI unconventional gas recovery symposium; Pittsburgh, PA, USA (13 May 1984).

In cooperation with Tiffany Gas Company, Terra Tek cored the Fruitland Formation coal, lying at approximately 3100 feet, in the Glover Well # 1 drilled in the southeast quarter of Section 2, T32N, R6W, Archuleta County, Colorado, within the northern portion of the San Juan Basin. The coal was fully water saturated. Laboratory tests were performed on the recovered cores and reservoir engineering tests within the coal before and after underreaming. Production data indicates the need to treat the coal with a deeply penetrating fracture to achieve acceptable gas production. However, coal fines migration is a serious problem to maintaining high production.

8336 **Negative decline curves of coalbed degasification wells.** Harrison, G.C.; Gordon, R.B. (Gary C. Harrison, Inc.). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE/DOE/GRI 12874**: 403-406(May 1984). (CONF-8405120—).

From SPE/DOE/GRI unconventional gas recovery symposium; Pittsburgh, PA, USA (13 May 1984).

Production data from coalbed degasification wells characteristically exhibit a negative decline curve. The dynamics of this methane production are complex and interrelated. As production begins, water and free gas are often first recovered. Continued production lowers pressure and increases permeability to gas, allowing adsorbed gas to flow. This pressure drop within the formation causes sublimation whereby gas, which is absorbed within the coal, forms on the walls of the micropores. Finally, the desorption through production disturbs the chemical and physical equilibrium of the coal, thus enabling the coal to resume generation of methane.

8337 **Coal as a conventional source of methane: A review and analysis of 50 wells in two production areas in the Black Warrior Basin of Alabama.** Dunn, B.W. (Enhanced Energy Resources). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE/DOE/GRI 12875**: 407-416(May 1984). (CONF-8405120—).

From SPE/DOE/GRI unconventional gas recovery symposium; Pittsburgh, PA, USA (13 May 1984).

This paper presents a review of the actual production, sales, and economic data from two production areas with 52 wells developed by a joint coal industry/gas industry effort owned equally by Jim Walter Resources, Inc. (JWR), a subsidiary of Jim Walter Corporation of Tampa, Florida and Enhanced Energy Resources, Inc. (EER), a subsidiary of Kaneb Services, Inc. of Houston, Texas. The unique reservoir characteristics of the coal environment are described in brief, a comparison of actual methane production from coal with computer model predictions is presented, and the capital and operating costs are discussed with specific emphasis on the economic results. This information differs from similar previous work in that economic vitality is now apparent whereas previous inquiries were essentially restricted to the technical reservoir engineering characteristics and the physical capability of coal to desorb (produce) methane. There are a number of published papers on this important technical aspect several of which are references for this presentation. Production Area I (31 well production area) has been generating an operating profit for the past 21 months. Profits have increased substantially in the past year as a result of the completion of an 8" transmission line and reduced operating costs. Initial production commenced in late 1979. A five well pilot project was evaluated for approximately two years before commercial development commenced in late 1981. A total of 31 wells were drilled by mid-

1982. First sales commenced in February of 1982. Production Area II drilling commenced in January of 1983 with initial sales in March of 1983. The economic viability is demonstrated based on actual operating profits over the past twentyone months and current experience with respect to improvements in operational techniques and costs. These data are applied to the computer forecasts of long term deliverabilities for projections of expected economic performance.

8338 **A combination air and fluid drilling technique for zones of lost circulation in the Black Warrior Basin.** Graves, S.L.; Beavers, W.M.; Niederhofer, J.D. (Graves Well Drilling Co.). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE/DOE/GRI 12873**: 397-402(May 1984). (CONF-8405120—).

From SPE/DOE/GRI unconventional gas recovery symposium; Pittsburgh, PA, USA (13 May 1984).

During the drilling of coalbed methane wells in the Black Warrior Basin, the possibility of penetrating a highly permeable fault or fracture zone is likely. These fracture zones, and occasionally the faults, are the source of large quantities of water. When air is being used as the drilling medium, problems may arise with producing and disposing of the formation water. When rotary drilling with fluid, loss of returns may also become a problem. The use of conventional lost circulation materials have been demonstrated-in this situation--to be both ineffective and expensive. Also, lost circulation materials substantially reduce the effective secondary permeability of the coal seams, severely limiting the ultimate methane production potential of the well. If the wellbore is generally competent, one inexpensive solution to the problem is to drill with air to a point where surface recovery tanks are full of produced formation water. Drilling can continue by switching to conventional fluid drilling until the surface storage tanks are pumped dry. This process of alternating fluid and air drilling can be continued until reaching total depth. Structural geologic information, available for the coal-bearing formations in the Black Warrior Basin, documents the occurrence of numerous fault and fracture zones. A combination air and fluid drilling technique may prove to be advantageous to coalbed methane operations in this and other areas with similar hydrologic and geologic conditions. Recently, this technique was successfully utilized on TRW, Inc., coalbed methane wells in Tuscaloosa County, Alabama.

8339 **Liquid permeability of coal as a function of net stress.** Rose, R.E.; Foh, S.E. (Inst. of Gas Tech.). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE/DOE/GRI 12856**: 253-260(May 1984). (CONF-8405120—).

From SPE/DOE/GRI unconventional gas recovery symposium; Pittsburgh, PA, USA (13 May 1984).

Coalbed methane production is initiated by the removal of formation water in quantities sufficient to accomplish a large reduction of fluid pressure in the cleat system. Pressure reduction causes gas to be desorbed from the coal; the cleat system channels this gas to the wellbore. The rate and quantity of water removal is limited by permeability of the cleat system which is usually stimulated to facilitate dewatering and gas production. Experiments were performed at IGT under in-situ conditions on coal from five U.S. basins. Results showed that water permeability of a given sample decreased by as much as two orders of magnitude over pressure ranges that simulated normal dewatering and production cycles. Knowledge of the behavior of permeability as a function of net stress allows a better understanding of the following realities of coalbed stimulation: 1) a horizontal drill hole of a given length is much more productive than a propped fracture of the same length; 2) in general, fractures induced in coalbeds are much shorter and wider than designed; and, 3) frac pressures in coalbeds are abnormally high significantly above overburden in many cases. Other consequences of a permeability-net stress functionality include: 1) skin factor determinations from injection tests are necessarily more optimistic than those based on drawdown data; 2) overbalanced drilling increases the invasion radius of drilling fluid filtrate, thereby creating the potential for more extensive formation damage than in conventional reservoirs; and, 3) leakoff during fracturing operations is significantly higher than for "conventional" sandstone or limestone beds having identical pre-injection permeabilities.

8340 **Effects of stress-dependent permeability on methane production from deep coal seams.** McKee, C.R.; Bell, G.J.; Bumb, A.C. (In-Situ Inc.). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE/DOE/GRI 12858**: 271-280(May 1984). (CONF-8405120—).

From SPE/DOE/GRI unconventional gas recovery symposium; Pittsburgh, PA, USA (13 May 1984).

Methane resources are frequently associated with deeply buried coal seams which are also saturated with water; therefore, knowledge of their hydrologic properties is essential. As the formation pressure is lowered during dewatering, permeability may decline by one to two orders of magnitude. Theoretical relationships have been developed which fit laboratory data well for porosity and permeability as a function of effective stress. It was discovered that for practical purposes permeability is a function only of effective stress and the ratio of initial fracture porosity to matrix compressibility (fracture closure pressure). An approximate analytical solution for well testing has been obtained using the model developed. A new method for pump test analysis is then proposed.

8341 **Use of a computer model to design optimal wellfields for dewatering coal seams for methane production.** Bumb, A.C.; McKee, C.R. (In-Situ Inc.). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE/DOE/GRI 12859**: 281-288(May 1984). (CONF-8405120—).

From SPE/DOE/GRI unconventional gas recovery symposium; Pittsburgh, PA, USA (13 May 1984).

A model is presented for optimizing the number and locations of wells for various hydrologic and reservoir conditions. It can handle confined or unconfined aquifers, leaky or non-leaky aquifers, isotropic or anisotropic permeabilities, existing wells at fixed or model-determined optimal flow rates, complex boundaries, and specified regions to be excluded from possible well location sites for environmental or other reasons. Examples demonstrate that optimum wellfield design differs significantly from the patterns widely used in the gas industry. Optimum patterns depend heavily on the reservoir and hydrologic characteristics of the target, the shape of the project site, existing wells, the total number of wells, and water pressure drop in the coal seam required to commence gas flow.

8342 **Modeling of asymmetric vertical growth in elogated hydraulic fractures and application to first MWX stimulation.** Palmer, I.D.; Craig, H.R. (Oral Roberts Univ.). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE/DOE/GRI 12879**: 453-462(May 1984). (CONF-8405120—).

From SPE/DOE/GRI unconventional gas recovery symposium; Pittsburgh, PA, USA (13 May 1984).

When a continuous sand is bounded by zones of higher, but unequal, minimum in-situ stress, a vertically asymmetric hydraulic fracture results. The modeling is much more difficult than in the symmetric case mainly because the width equation is harder to formulate and solve. In this paper we present the principal components of the modeling, which includes non-Newtonian flow, leakoff with spurt loss, and "storage" of fluid due to volume expansion. The assumption is that the fracture is highly elongated, i.e., stress contrasts between pay and bounding zones are relatively large (> about few hundred psi). Vertical gradients of minimum in-situ stress and fluid pressure can be included in the modeling. To illustrate, the results, we present design calculations for a 30,000 gallon fracture, which was the first stimulation in the Multi-Well Experiment. The 80 ft fracture interval in the Paludal zone has at its upper edge a 520 psi stress contrast, and at its lower edge a 1195 psi contrast. Computed fracture height growth above and below the perforated interval, bottomhole pressure, and width profiles in vertical sections are displayed. Comparison is made with diagnostic measurements of fracture length, height, and bottomhole pressure.

8343 **Evaluation of naturally fractured gas shale production utilizing multiwell transient tests: A field study.** Chen, C.C.; Alam, J.; Blanton, T.L.; Vozniak, J.P. (Science Applications Inc.). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE/DOE/GRI 12872**: 381-396(May 1984). (CONF-8405120—).

From SPE/DOE/GRI unconventional gas recovery symposium; Pittsburgh, PA, USA (13 May 1984).

A series of multiple well transient tests were conducted in a Devonian shale gas field in Meigs County, Ohio. Production parameters were quantified and it was determined that the reservoir is highly anisotropic, which is a significant factor in calculating half-fracture length from pressure transient data. Three stimulation treatments, including conventional explosive shooting, nitrogen foam frac, and high energy gas frac (HEGF), were compared on the basis of overall effectiveness and performance. Based on the evaluation of results, the nitrogen foam frac provided the most improved productivity. The study provided new type curves and analytical solutions for the mathematical representation of naturally fractured reservoirs and confirmed that the shale reservoir in Meigs County can be modeled as a dual porosity system using pseudosteady-state gas transfer from the matrix to the fracture system.

8344 **Applicability of tailored pulse loading for gas well stimulation.** Keough, D.D.; Curran, D.R.; McHugh, S.L. (SRI International). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE/DOE/GRI 12837**: 67-76(May 1984). (CONF-8405120—).

From SPE/DOE/GRI unconventional gas recovery symposium; Pittsburgh, PA, USA (13 May 1984).

Tailored-pulse loading is a gas well stimulation technique that is promising for particular situations. The key factor in determining the probability of success is the interaction of the loading history with the material properties and in situ stresses of the geologic formation. On the basis of theoretical and experimental studies, tailored-pulse loading is expected to be successful if (a) the rock is fairly competent, (b) the yield stress is greater than about 100 MPa, (c) the overburden pressure is less than about 100 MPa, (d) the natural fracture or joint spacing is less than several meters.

8345 **A propellant-based technology for multiple fracturing wellbores to enhance gas recovery: Application and results in Devonian shale.** Cuderman, J.F.; Northrop, D.A. (Sandia National Laboratories). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE/DOE/GRI 12838**: 77-86(May 1984). (CONF-8405120—).

From SPE/DOE/GRI unconventional gas recovery symposium; Pittsburgh, PA, USA (13 May 1984).

A propellant based technology has been developed that permits control of borehole pressurization to obtain multiple radial fractures about the wellbore. The objective is to connect nonintersecting natural fractures in a reservoir to the wellbore and thereby stimulate increased production. Techniques are presented for specifying the pressure pulse required for producing multiple fractures and for choosing propellants to achieve the desired pressure pulse. The multiple fracturing technique was specifically developed for application in naturally fractured Devonian shale gas reservoirs. A stimulation experiment in a Devonian shale gas well successfully increased production from 6,700 ft ^{3}/day to 22,000 ft ^{3}/day (190 m^3/day to 623 m^3/day).

8346 **Multiple fracture stimulation using controlled pulse pressurization.** Hanson, J.M.; Cooley, C.H.; Schatz, J.F.; Schmidt, R.A. (Terra Tek Inc.). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE/DOE/GRI 12839**: 87-94(May 1984). (CONF-8405120—).

From SPE/DOE/GRI unconventional gas recovery symposium; Pittsburgh, PA, USA (13 May 1984).

Tight oil and gas reservoirs often require stimulation in order to make economic exploitation possible. Tailored pulse loading, usually by downhole use of propellants or explosives, has been studied as a means of improving production in these reservoirs. This paper presents an overview of the first year's effort on a three-year combined theoretical-experimental research program to develop a systematic understanding of the tailored pulse loading/fracturing phenomena. The project is designed to address the sensitivity of multiple fracture initiation and propagation to rock and fluid properties and pressurization history. The results will ultimately contribute to the design procedures for field applications.

8347 **Perforation placement optimization: A modified hydraulic fracturing technique.** Ahmed, U.; Hathaway, S.; Kelkar, S.M.; Thompson, T.W.; Veghte, R. (Terra Tek Inc.). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE/DOE/GRI 12841**: 101-114(May 1984). (CONF-8405120—).

From SPE/DOE/GRI unconventional gas recovery symposium; Pittsburgh, PA, USA (13 May 1984).

The success of a hydraulic fracture treatment is greatly enhanced by control of the created fracture geometry. This problem is most serious if the boundary lithologies are not highly stressed as compared to the pay zone and do not form an effective barrier to upward migration. Reservoirs with this nature are common in many areas, including the Douglas Creek Arch, Green River Basin, Uintah Basin, San Juan Basin, and Central Alberta. The Perforation Placement Optimization technique involves the determination of perforation locations such that the hydraulic fracture contact area within the pay zone is optimized. Where the upper boundary lithologies are not highly stressed as compared to the pay zone, the fracture will migrate predominantly upward into weak boundary lithologies. Where weak boundaries exist, the extent of the exposed fracture area that can be contained within the pay zone is strongly dependent on the location of the perforations and the gross height of the pay formation. Initiating the

8348 **Cavity stress relief method to stimulate demethanation boreholes.** Alain, A.K.; Denes, G.M. (Novacrop International Consulting Services). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE/DOE/GRI 12843**: 115-122(May 1984). (CONF-8405120—).

From SPE/DOE/GRI unconventional gas recovery symposium; Pittsburgh, PA, USA (13 May 1984).

Most demethanation programs which use boreholes from the surface to access the coal, incorporate a stimulation program to enhance the well production. In most cases, the stimulation selected is a frac using nitrogen foam or other fluids. Novacorp has determined that fracing the coal may not be the best technique to apply to a well. Novacorp, whose experience includes over eighteen (18) fracs on demethanation wells, has developed and patented an alternative stimulation method, called the Cavity Stress Relief (CSR) technique, which it believes is more effective than the frac, in most cases. Through a review of the basic parameters which affect the desorbtion of gas from coal, a comparison is made between the frac and CSR stimulation techniques. A description of the conditions and results of two field tests of CSR are given. Also, the areas which need further development will be discussed. Although still not totally proven, the CSR stimulation technique promises to be a very effective method of stimulating most demethanation wells.

8349 **Analyzing gas well buildup tests with changing wellbore storage in tight gas.** Lee, W.J.; Holditch, S.A.; Retna, T.; Whithead, W.S. (Texas A & M University). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE/DOE/GRI 12845**: 147-162(May 1984). (CONF-8405120—).

From SPE/DOE/GRI unconventional gas recovery symposium; Pittsburgh, PA, USA (13 May 1984).

Pre-fracture pressure buildup tests in tight gas formations can be extremely difficult to analyze correctly, particularly when large pressure drawdowns precede the shut-in period. A major source of difficulty is the wellbore storage coefficient, which changes continuously throughout the test and which can change by one to two orders of magnitude from beginning to end of the test. This change causes particular problems in typecurve analysis; in turn, this can cause serious difficulties in recognizing when, if ever, the semi-log straight line with slope related to formation permeability appears. As a result, buildup test analysis results can be the sub-

ject of great controversy and uncertainty. This paper summarizes research which shows conditions under which changing storage coefficient causes interpretation problems and which also shows how the use of Agarwal's pseudo-time function can resole the difficulties. Simulated buildup test analyses are used to show the problem and its solution. Several actual tests from tight gas formations also illustrate the difficult-to-analyze shapes suggested by theory, and the correct analysis of these tests is presented.

8350 **An automated method of matching production performance using dimensionless solutions.** Holditch, S.A.; Gatens, J.M.; Lancaster, D.E.; McVay, D.A. (Texas A & M University). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE/DOE/GRI 12846**: 163-174(May 1984). (CONF-8405120—).

From SPE/DOE/GRI unconventional gas recovery symposium; Pittsburgh, PA, USA (13 May 1984).

In this paper, the authors describe a technique which can be easily programmed by most engineers dealing with post-fracture formation evaluation problems. In addition, additional type-curve data have been introduced to the industry. Simple typecurve models can be very useful; however, when real gas pseudo-pressures, real gas pseudo-times, superposition, and an automatic history-matching routine are included, the simple type-curve model can be transformed into a very efficient and powerful reservoir evaluation tool.

8351 **Estimating formation permeability from single-point flow data.** Lee, W.J.; Holditch, S.A.; Kuo, T.B.; McVay, D.A. (Texas A & M University). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE/DOE/GRI 12847**: 175-186(May 1984). (CONF-8405120—).

From SPE/DOE/GRI unconventional gas recovery symposium; Pittsburgh, PA, USA (13 May 1984).

Many operators do not routinely run pre-stimulation pressure buildup tests in low permeability gas reservoirs. Frequently, all that is available is a single-rate flow test. To obtain permeability estimates for FERC filings and to evaluate the reservoir, a new method has been developed for analyzing typical pre-fracture production data. Permeability estimates obtained from this method have been used as a major source of data in numerous successful tight gas determinations, including the Cotton Valley, Wilcox Lobo, and Canyon formations in Texas. The paper shows that this simple method can be quite reliable. This conclusion is based on a comparison of permeabilities estimated with this technique and with more rigorous determinations from pressure buildup tests.

8352 **Fracture diagnostics results for the multiwell experiment's paludal zone stimulation.** Hart, C.M.; Engi, D.; Fleming, R.P.; Morris, H.E. (Sandia National Laboratories). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE/DOE/GRI 12852**: 221-228(May 1984). (CONF-8405120—).

From SPE/DOE/GRI unconventional gas recovery symposium; Pittsburgh, PA, USA (13 May 1984).

A dual seismic system designed to monitor the growth of hydrofractures was fielded during the first stimulation at the DOE-sponsored Multi-Well Experiment (MWX) during December 1983. The MWX consists of three 8000-ft wells which have been drilled in low permeability gas reservoirs. The wellbores are spaced less than 200 ft apart over most of their length. With this configuration, microseismic activity created by the fracture treatment in one well could be observed with downhole geophone packages in the two adjacent wells. The responses of the two triaxial borehole seismic tools were monitored in real time and analyzed post-frac. Upon the detection of a seismic event of known location, orientations of the tools were determined from the polarization of the compressional wave arrivals. From knowledge of the horizontal and vertical angles of incidence and an empirical estimate of seismic velocities, the location of the fracture induced seismic sources was estimated. Thus, the location of the microseisms could be estimated and, in turn, the fracture height and extent inferred. This paper presents the results of the fracture diagnostics using this borehole seismic system for the first MWX stimulation. This information is compared to and combined with the results obtained from other diagnostic techniques to provide an integrated estimate of the fracture geometry resulting from the stimulation.

8353 **Current status of the Multiwell Experiment.** Northrop, D.A.; Frohne, K.H.; Mann, R.L.; Sattler, A.R. (Sandia National Laboratories, Albuquerque, NM). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE/DOE/GRI 12868**: 351-358(May 1984). (CONF-8405120—).

From SPE/DOE/GRI unconventional gas recovery symposium; Pittsburgh, PA, USA (13 May 1984).

The Multi-Well Experiment (MWX) is a research oriented field laboratory whose objective is to develop the understanding and technology to allow economic production of the several years supply of natural gas estimated to be within the low permeability, lenticular gas sands of the Western United States. Features of MWX include: (1) three closely-spaced wells (115-215 ft, 35-66 m) for reservoir characterization, interference testing, well-to-well geophysical profiling, and placement of diagnostic instrumentation adjacent to the fracture treatment; (2) complete core taken through the formations of interest; (3) a comprehensive core analysis program; (4) an extensive logging program with conventional and experimental logs; (5) determination of in situ stresses in sands and bounding shales; (6) use of various seismic surveys and sedimentological analyses to determine lens morphology and extent; (7) use of seismic, electrical potential, and tilt diagnostic techniques for hydraulic fracture characterization; and (8) a series of stimulation experiments to address key questions. This paper presents the current MWX accomplishments resulting from the 1983 field season which featured the drilling of a third well and the first stimulation experiment.

8354 **Enhanced production from a slightly geopressured water-drive gas condensate field.** Anderson, L.L.; Parisi, W.A.; Peterson, K.P. (Eaton Operating Co., Inc.). *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* **SPE/DOE/GRI 12866**: 341-350(May 1984). (CONF-8405120—).

From SPE/DOE/GRI unconventional gas recovery symposium; Pittsburgh, PA, USA (13 May 1984).

The production history of a Texas Gulf Coast Frio water drive gas field is presented, including performance data from a well which was recently restored to commercial production after having been abandoned six years. Areas of additional study which would help forecast future performance are discussed.

0320 Transport, Pipelines, And Handling

8355 **Ultrasonic inspection of polyethylene butt-fussion joints.** House, L.J.; Day, R.A. (Battelle Columbus Lab., OH). *American Gas Association, Operating Section, Proceedings;* D267-D280(1982).

Researchers investigated nondestructive pulse-echo, pitch-catch, and spectroscopic ultrasonic methods for determining voids and inclusions, lack of bond, and inadequate fusion in heat-fused polyethylene butt joints in 4-in. gas distribution pipe. The pulse-echo method, using a 2.25-MHz, cylindrically focused transducer, provided the best sensitivity to the joint defects, detecting flaws as small as 0.014 in. in diameter. No correlation was established between the ultrasonic spectroscopy results and the cohesive strength of incompletely fused joints in the 1.2-3.2 MHz frequency range.

0340 Combustion

REFER ALSO TO CITATION(S) 0340008243, 8252, 8285, 8286

04 OIL SHALES AND TAR SANDS

8356 **Department of Energy's oil shale R, D, and D (research, development, and demonstration) program: an overview.** Hartstein, A.M.; Harney, B.M. *ACS Symposium Series;* No. 163, 1-12(1981).

The largest untapped fossil fuel resource in the US is the oil-bearing shales in the western part of the country and the black shales in the east. The oil shale resource concentrated in 3 western states is estimated to be equivalent to more than 2 trillion bbl of crude oil. An additional 2 trillion bbl of oil exists in the lean deposits of the eastern US. The Department of Energy (DOE) has established a research, development, and demonstration program for encouraging the development of the country's oil shale resource to help in the mitigation of the present and future energy demands. The aim of the oil shale program is to stimulate the commercial production of shale oil by eliminating technical and environmental barriers. This work provides an overview of the DOE oil shale research, development, and demonstration program, addressing its essential elements.

0404 Oil Production, Recovery, And Refining

REFER ALSO TO CITATION(S) 0404008280

8357 **(DOE/FE/60177—1680) Oil shale, tar sands, and underground coal gasification. Quarterly progress report, April-June 1984.** (University of Wyoming Research Corp., Laramie (USA)). 15 Aug 1984. Contract FC21-83FE60177. 67p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85000818.

Highlights of progress achieved during the quarter ending June 30, 1984 are summarized. This research involves three resource areas: oil shale, tar sands, and underground gasification of coal. Separate abstracts have been prepared for each section for inclusion in the Energy Database. (DMC)

8358 (DOE/FE/60177—1680, pp 1.1-1.34) **Oil shale: Western Research Institute quarterly technical progress report, April-June 1984.** 15 Aug 1984. NTIS, PC A04/MF A01. File Number DE85000818.

In Oil shale, tar sands, and underground coal gasification. Quarterly progress report, April-June 1984.

Highlights of progress achieved during the quarter ending June 30, 1984 in in-situ oil shale processing are summarized. Modifications to the Lawrence Livermore National Laboratory (LLNL) one-dimensional retorting model are improving the predictive capabilities for evaluating retort operations. A model for oil mist formation and deposition is being formulated based on the results of another DOE research contract. Improvements in reactor configuration and operating procedures are extending the temperature range for isothermal measurements of kerogen decomposition kinetics. Polished data on coal pyrolysis have been researched for comparison with current results of kerogen decomposition experiments. Equipment and operating procedures for measuring kinetics of oil degradation reactions have been tested in some preliminary experiments. Oil shale compaction during retorting has been measured in 3 low void retorting tests. Results of previous nonuniform flow distribution tests in the 10-ton retort have been evaluated in comparison to alternative characterizations of the particle size distribution. A number of auxillary programs have been developed for displaying and analyzing the 10-ton retorting test data in comparison with the one-dimensional retorting model. Gas tracer measurements of flow nonuniformities in the 10-ton retort have been investigated using a one-dimensional dispersion model in conjunction with a two-dimensional model for calculating gas velocities and tracer responses. Research is in progress to extract organics from oil shale at shorter residence times. Acid-extracted Green River Formation oil shale is being treated with radical forming reagents to aid in interpretation of kerogen decomposition mechanisms. Environmental impact mitigation studies are continuing in gaseous and waste water emission control. 5 references, 5 figures, 6 tables.

8359 (DOE/FE/60177—1680, pp 2.1-2.14) **Tar sand: Western Research Institute quarterly technical progress report, April-June 1984.** 15 Aug 1984. NTIS, PC A04/MF A01. File Number DE85000818.

In Oil shale, tar sands, and underground coal gasification. Quarterly progress report, April-June 1984.

Highlights of progress in in-situ oil sand retorting are summarized. The block reactor has been installed at the In Situ Processing Laboratory to conduct three-dimensional recovery experiments based on the one-dimensional screening tests in the tube reactor. The operating manual has been completed, and all equipment and procedures have been inspected and approved. Initial tube reactor tests using reverse combustion followed by steam injection have poor recovery of oil during the steamflood. Over 50% of the oil is recovered during the reverse combustion. In these tests, the ignition temperature is about 600°F, and the reverse combustion moves through the tar sand at a rate of about 7 ft/day. However, there is no significant recovery of additional oil during the steamflood following the reverse combustion. General sample preparation and analyses for product oils from the first series of steam displacement tests are nearing completion. Results indicate that most of the oil is produced by viscosity reduction and thermal expansion. Reservoir characteristics have been analyzed for two Utah deposits. An extensive literature search was initiated to catalog and evaluate novel recovery methods that might be applicable to domestic tar sand. The two objectives involving process water cleanup were: to complete the effort supporting the federal in situ project in Vernal, Utah; and to expand the data base from this project into areas of other tar sand resource and/or differing extraction processes. The following work was accomplished: (1) completion of a multi-stage flotation study designed to improve hydraulic efficiencies and provide boiler quality destabilized bitumens; (2) initiation of a more detailed toxicological evaluation of treated tar sand process waters; and (3) initiation of activities necessary to secure a large sample of process water from a Texas in situ extraction project. 4 references, 1 figure, 1 table.

8360 **(DOE/LC/10127—1640) Factors affecting in-situ recovery of hydrocarbons from oil shale.** Tyler, A.L.; Kafesjian, A.S.; Fischer-Calderon, P.E. (Utah Univ., Salt Lake City (USA)). Jul 1984. Contract AC20-79LC10127. 476p. NTIS, PC A21/MF A01; 1; GPO Dep. File Number DE84012010.

Batch thermal solution of Hell's Hole Canyon oil shale in hydrocarbon solvents has been studied at temperatures of from 274° to 410°C. Three solvents were used: cyclohexane; 1,2,3,4-tetrahydronaphthalene; and creosote oil. In 24-hour, constant-temperature runs under autogenous pressure, each solvent was found to be capable of removing over 90% of the original organic material at extraction temperatures of from 360 to 375°C. Cyclohexane extraction resulted in somewhat greater yields than tetralin extraction in runs below 365°C but approximately the same yields as tetralin at higher extraction temperatures. With one oil shale sample, virtually identical yields were observed in both cyclohexane and tetralin extractions. This finding suggests that mass-transfer restrictions within some oil shales may restrict the yield regardless of the solvent used. Carbon-13 NMR analyses of the spent shales showed that the aromaticity of the residual organic material in tetralin-extracted shale increased slightly from the raw shale value of 0.27 and remained essentially constant at a value of 0.31 increased. In constant temperature runs of 24-hour duration, the aromaticity of an oil shle sample increased from the raw oil shale value of 0.17 to 0.28 after cyclohexane extraction at 326°C, while a tetralin-extracted sample of the same oil shale had an aromaticity of only 0.20 after extraction at 321°C. The nitrogen content of the cyclohexane extracts, which ranged from 1.58 to 2.24%, was comparable to that of values reported in the literature for shale oils. The tetralin extracts had somewhat lower nitrogen content, ranging from 0.58 to 1.95%. Extract nitrogen content generally increased with extraction temperature. 55 references, 58 figures, 22 tables.

0405 Properties And Composition

REFER ALSO TO CITATION(S) 0405008279, 8299, 8300, 8301, 8359, 8360

8361 **(AD-A—145691/2) Alternate fuels combustion research. Final report May 1980-September 1983.** Gratton, M.; Critchley, I.; Sampath, P. (Pratt and Whitney Canada, Mississauga, Ontario). Jul 1984. 360p. NTIS, PC A16/MF A01.

This report presents the results of the Alternate Fuels Combustion Research program. The effects of variations in fuel properties on the performance of a can, PT6A-65, and JT15D-5 combustion systems were determined. Sixteen different fuels were used, encompassing a wide range of chemical and physical properties. The

tests covered current specification, broadened specification and alternate source (shale and tar sands derived) fuels.

8362 **(PB—85-106417/XAD) Oil shale creep testing at elevated temperatures. Open file report 28 January 1982-28 April 1983.** Sinha, K.P.; Borschell, T.F.; Schatz, J.F. (Terra Tek, Inc., Salt Lake City, UT (USA)). 6 Jul 1983. 162p. NTIS, PC A08/MF A01.

An investigation was made to determine the creep behavior of oil shale at elevated temperatures. During the first phase of the investigation, work done on creep behavior of geologic materials was reviewed and triaxial creep tests on oil shale were planned. Tests at temperatures up to 250 degrees C and axial stress up to 3,000 psi were conducted at no confinement and at confining pressures equal to one-third and two-thirds of axial stress. Wide variations in the elastic properties as well as creep characteristics are exhibited. Creep deformation is more pronounced at elevated temperature but no definite quantitative remarks can be made regarding effect of grade of oil shale due to wide scatter and limited number of data points. Primary creep can be described by a power law. Secondary creep seems to be an experimental function of deviatoric stress. Teritary creep was not observed within the test period.

05 NUCLEAR FUELS

0503 Mining

REFER ALSO TO CITATION(S) 0503008420

0504 Feed Processing

8363 **(DGRST—76-7-0010) Study of new solvent for trace metal extraction, application to uranium extraction in phosphate attack solutions for phosphoric acid production.** Sibut, R.; Lampin, J.P. (Delegation Generale a la Recherche Scientifique et Technique (DGRST), 75 - Paris (France)). Oct 1978. 8p. (In French). NTIS (US Sales Only), PC A02/MF A01. File Number DE84752343.

In this article the chemical preparation of three organic phosphorus compounds: tricyclohexylphosphine oxide, cyclohexylphosphonic acid 4-octylphenyl monoester, and tetraoctyl ethylene disphosphine oxide is described. Products obtained were analyzed.

8364 **(DGRST—76-7-1378) Trace recovery of uranium and rare earth contained in phosphates by liquid-liquid extraction in sulfuric attack liquor.** Bousquet, F.; Foraison, D.; Leveque, A.; Sabot, J.L. (Delegation Generale a la Recherche Scientifique et Technique (DGRST), 75 - Paris (France)). Jun 1980. 33p. (In French). NTIS (US Sales Only), PC A03/MF A01. File Number DE84752344.

Uranium and rare earths can be recovered in sedimentary phosphates during the wet processing of the ore by sulfuric acid giving raw phosphoric acid at 30 per cent of P_2O_5. Practically all the uranium contained and only part of rare earths are put into solution in this treatment. Separation of these elements in the phosphoric solution is obtained by liquid-liquid extraction with alkylphosphoric acids and especially with their mono and di esters. Partition isotherms are determined and counter-current tests are effected. Uranium and rare earths reextraction from these solvents can be simultaneous or separate with aqueous solutions alkaline or containing HF or by antisynergism. Pros and cons of each reextraction process are discussed. In conclusion HDEHP or OPPA are recommended because of availability, stability and hydrodynamic, OPPA less selective with rare earths allows the recovery with uranium of ceric earths, yttrium and yttric earths.

0505 Enrichment

REFER ALSO TO CITATION(S) 0505008417, 8432

8365 **(CONF-830642—) Gases in strong rotation: proceedings of the fifth workshop.** Wood, H.G. III (ed.). (Virginia Univ., Charlottesville (USA). School of Engineering and Applied Science). 1983. Contract AC05-82OR20900. 859p. NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE84006270.

From 5. international workshop on gases in strong rotation; Charlottesville, VA, USA (5 Jun 1983).

Separate abstracts were prepared for 20 papers in this proceeding. Five other papers are included in the proceedings that had been indexed previously for EDB. (LEW)

8366 (CONF-830642—, pp 2-42) **Analysis of separation performance of gas centrifuge.** Kai, Tsunetoshi. (Power Reactor and Nuclear Fuel Development Corp., Tokyo, Japan). 1983. NTIS, PC A99/MF A01. File Number DE84006270.

From 5. international workshop on gases in strong rotation; Charlottesville, VA, USA (5 Jun 1983).

The method is briefly described in which fully converged numerical solutions are obtained for the flow and diffusion equations in static state, using a modified version of the Newton method. In the succeeding sections, the validity of this method is examined by comparing the solutions with the experimental data made by Beams et al. and Zippe. In the last section, theoretical pressure distributions and separative powers are compared respectively with experimental ones on a relatively recent centrifuge, with detailed analyses and discussions being included.

8367 (CONF-830642—, pp 43-54) **Velocity measurements of UF_6 gas in strong rotation using a laser ion time-of-flight (LITOF) method.** Krauss, R.H.; Scoles, S.H.; Scott, J.E. Jr. (Virginia Univ., Charlottesville). 1983. NTIS, PC A99/MF A01. File Number DE84006270. Contract AC05-82OR20900.

From 5. international workshop on gases in strong rotation; Charlottesville, VA, USA (5 Jun 1983).

A time-of-flight method has been applied to velocity measurements of UF_6 gas in strong rotation. A focused N_2 laser was used to create breakdown in UF_6 gas, resulting in a highly resolved (spatially and temporally) packet of ions. Ion lifetimes in the density range of interest were sufficiently long to permit detection with a small biased ion collector probe after several rotor revolutions. Spatial spreading of the packet was sufficiently small to enable precise pulse timing, and radial migration of the ion packet over several revolutions was not evident. Angular (or azimuthal) velocity measurements indicate that, in the absence of significant flow perturbations, the angular velocity is constant over the radial range measured and equal to within 1% of the angular velocity at the rotor wall. Introduction of a scoop into the gas is found to result in a roughly linear relationship between the percentage deviation of angular velocity (from that corresponding to solid body rotation) and scoop drag for low density regions. Measurements of the radial displacement of the ion packet over several rotor revolutions indicated radial velocities less than .001 of the rotor peripheral velocity. Axial velocity measurements obtained ranged up to .015 of the rotor peripheral velocity.

8368 (CONF-830642—, pp 55-159) **Analytic solution for the separative power of gas centrifuges.** Raetz, E. (Gesellschaft fuer Centrifugentechnik mbH, (CENTEC), Bergisch Gladbach, Germany). 1983. NTIS, PC A99/MF A01. File Number DE84006270.

From 5. international workshop on gases in strong rotation; Charlottesville, VA, USA (5 Jun 1983).

Purpose of this paper is to derive simple analytic solutions for the enrichment and the separative power obtainable with gas centrifuges during uranium isotope separation.

8369 (CONF-830642—, pp 187-221) **Unclassified spots on history of modern gascentrifuges.** Zippe, G. 1983. NTIS, PC A99/MF A01. File Number DE84006270.

From 5. international workshop on gases in strong rotation; Charlottesville, VA, USA (5 Jun 1983).

Gascentrifuges are an almost unlimited source of unresolved, interesting, and challenging scientific problems for theorists as well as for experimenters in the field of gasdynamics, mechanics, static stress, and passing critical speeds of unusual spinning gyros. The chemists find their task in avoiding corrosion or in stress-corrosion problems. Because of the world-wide cooperation of many brilliant and dedicated people in both East and West, most of the problems have found a solution good enough to justify technical and even competitive commercial application. The least difficult aspect of gascentrifuge development was the grouping of single centrifuges to form cascades. Though the problems of driving the centrifuges in big numbers, like synchronous clocks only much faster, gave new incentive to the electrical engineers. The scrutiny of the performance of thousands of spinning tubes stimulated the microprocessor people to design an automatic, reliable, self-controlling system.

8370 (CONF-830642—, pp 223-246) **Numerical solutions for the flow due to rotating cylinders and disks.** Jones, I.P.; Cliffe, K.A. (Atomic Energy Research Establishment, Harwell, England). 1983. NTIS, PC A99/MF A01. File Number DE84006270.

From 5. international workshop on gases in strong rotation; Charlottesville, VA, USA (5 Jun 1983).

This paper presents numerical results for two well known rotating flow problems. The first is the Taylor problem of the flow between an inner rotating cylinder and an outer stationary cylinder. The exchange process between a four-cell and a six-cell flow is studied numerically using two independent numerical methods and the results compared with the experimental results of Mullin. The numerical results are in excellent agreement with each other and in qualitative agreement with the experimental results. There are, however, small systematic differences between the predictions and the experimental results. The second problem is the flow between two finite coaxial rotating disks. Two cases are studied: one with a large separation between the disks and one with a narrow gasp between the disks. The results are in qualitative agreement with predictions from similarity solutions for infinite disks over much of the domain. There is also evidence of multiple solutions for the case when the disks are counter-rotating and close together.

8371 (CONF-830642—, pp 247-275) **Analytic solution of the linearized flow equations using the method of eigenvalues.** Jung, E. 1983. NTIS, PC A99/MF A01. File Number DE84006270.

From 5. international workshop on gases in strong rotation; Charlottesville, VA, USA (5 Jun 1983).

In a strongly rotating cylinder, filled with an ideal gas, the asymptotic case of the flow with little velocity is searched. Proceeding from the rigid rotation a linear set of partial differential equations is received by application of a perturbation method.

8372 (CONF-830642—, pp 277-309) **About the centrifuge feed flow field.** Lopez, S. (Comitato Nazionale Energia Nucleare, Rome, Italy). 1983. NTIS, PC A99/MF A01. File Number DE84006270.

From 5. international workshop on gases in strong rotation; Charlottesville, VA, USA (5 Jun 1983).

The flow field generated in a centrifuge by the introduction and the extraction of a feed gas was investigated. In the numerical calculations, the reference centrifuge with the reference conditions of operation was considered. The feed gas is introduced at half the centrifuge height by means of a central tube 20 cm in diameter, placed in the upper half of the centrifuge, the gas extraction occurring through two peripheral circular 1.5 cm wide slits on the two end caps, respectively. Although the gas pressure at the centrifuge axis is of the order of 10^{-6} torr, the flow field was obtained by solving the differential system composed by the Navier-Stokes, continuity, energy and state equations. The case was considered in which the gas is forced to enter the centrifuge by a given overpressure at the feed tube, while the pressure at the exit slits is kept constant and equal to that in solid body rotation. The problem is strongly nonlinear especially in the regions close to the feed and to the extraction points, and so the differential equation system above had to be solved in its complete form.

8373 (CONF-830642—, pp 311-365) **Comparison between the theory of 6th and 8th order using the GSR Rome model centrifuge as example.** Schoenfelder, R. 1983. NTIS, PC A99/MF A01. File Number DE84006270.

From 5. international workshop on gases in strong rotation; Charlottesville, VA, USA (5 Jun 1983).

The general analytic method of solving the flow field in centrifuges by H.G. Wood III (theory of 6th order) and E. Jung (theory of 8th order) is applied to the GSR Rome model centrifuge to calculate the separative power for various velocities and different temperature distributions in the rotor wall. In contrary to expectations relatively large differences occur in the efficiency depending on the boundary conditions applied. These differences are caused by changes in the axial profile delta w in radial and axial direction, respectively by changes in the stream lines. For a temperature step at the waste end cap and otherwise constant rotor temperature, the decay of the axial profile is stronger if the 6th order theory is used compared to the 8th order theory. If a linear temperature distribution in the rotor wall is used and constant temperature along the end caps the behavior is just opposite. In this case the axial flow profile shows a stronger axial gradient near the end caps for the 8th order theory than for the 6th order theory. Because of a simultaneous change of the radial and axial distribution of delta w no general tendency could be found with respect to changes in separative power. For example it is not possible to say in general that separative power increases if the average decay decreases and vice versa.

8374 (CONF-830642—, pp 371-392) **Gas flow tracing technique applicable to rotating systems boundary layer on a rotating disk.** Keyes, J.J. Jr.; Johnson, B.L. Sr.; Park, J.E. (Oak Ridge Gaseous Diffusion Plant, TN). 1983. NTIS, PC A99/MF A01. File Number DE84006270.

From 5. international workshop on gases in strong rotation; Charlottesville, VA, USA (5 Jun 1983).

A sensitive flow tracing technique applicable to remote rotating systems is described and demonstrated for the simple case of a disk rotating in air. The technique is based on the formation of a plume of silver iodide by reaction of iodine trace vapor, convected by the air flow relative to the disk, with silver foil attached to the surface. The plume is in effect an image of the flow made visible by the colored interference fringe pattern due to the optically thin silver iodide. By the use of a delayed iodine release technique described in the paper, this flow tracing method can be extended to remote geometries for which conventional methods may be unsuitable. The experimentally observed patterns are compared with computer generated patterns based on T. von Karman's analytical solution coupled with a numerical model for the three-dimensional transport of iodine vapor. The applicability of von Karman's solution is verified, and the usefulness of the experimental method for correlating speeds of air relative to the disk is demonstrated.

8375 (CONF-830642—, pp 425-457) **Numerical investigations of the flow field near a model of a scoop using the vortex transport equations.** Walz, A.; Volosciuk, K.; Schuetz, H. 1983. NTIS, PC A99/MF A01. File Number DE84006270.

From 5. international workshop on gases in strong rotation; Charlottesville, VA, USA (5 Jun 1983).

The numerical investigations presented in this paper are a consequent continuation to those reported on the 4th Workshop by K. Volosciuk (1). Since it became obvious from those foregoing results that the simulation of the scoop by a non-rotating disc in the 2D-case gave very strong secondary flows, 10% slipping parts in this case have been assumed. The Reynolds and Mach numbers were kept in about the same range as before. As the most important step in the (hopefully) right direction we believe to recognize a change in the finite difference scheme which now consists in a suitable combination of central and upwind-differencing and uses meshsize dependant relaxation. This new relaxation method (denoted as Quasi simultaneous relaxation) gave surprisingly reasonable and stable results with remarkably reduced computer time. Due to these improvements of the numerical method the geometrical domain of the numerical solution was extended to include also a part of the separation chamber, to simulate a baffle and to treat the 3D-case of a scoop simulation by a stationary quarter disc. Since the history of

the development of this numerical method within the past about 1-1/2 years was described in detail in a report of E. Raetz (2), we may omit here a detailed presentation of the numerical scheme.

8376 (CONF-830642—, pp 459-477) **Ekman layer matching in finite-difference analyses of strongly rotating flows.** Ribando, R.J.; Wood, H.G. III. (Virginia Univ., Charlottesville). 1983. NTIS, PC A99/MF A01. File Number DE84006270.

From 5. international workshop on gases in strong rotation; Charlottesville, VA, USA (5 Jun 1983).

Under conditions of strong rotation the thickness of the Ekman layers on horizontal boundaries is such that their resolution using a very fine finite-difference mesh may be extremely time-consuming and costly. As an alternative we consider the application of a matching condition in place of full resolution. This matching will be seen to have the same effect on the flow outside the Ekman layers as would direct application of the no-slip condition on a highly refined mesh. We consider primitive variable solutions of both incompressible and compressible flows. In the former case the results will be shown to compare favorably with results obtained using full resolution on a fine mesh and also with recently-made LDV measurements. The results for the latter case are comparable to predictions obtained from both finite-element and eigenfunction solutions of the Onsager Pancake formulation.

8377 (CONF-830642—, pp 511-514) **Status of the US gas centrifuge program.** Gestson, D.K. (Department of Energy, Washington, DC). 1983. NTIS, PC A99/MF A01. File Number DE84006270.

From 5. international workshop on gases in strong rotation; Charlottesville, VA, USA (5 Jun 1983).

The gas centrifuge program in the US is briefly discussed, including the Gas Centrifuge Enrichment Plant in Portsmouth, Ohio, and advanced gas centrifuge technology. (LEW)

8378 (CONF-830642—, pp 515-532) **Simulation of gas flow in front of the scoop of a gas centrifuge.** Hittinger, M.; Holt, M.; Soubbaramayer; Cortet, C. (Compagnie Internationale de Services en Informatique, Saclay, France; Univ. of California, Berkeley; CEA, Saclay, France). 1983. NTIS, PC A99/MF A01. File Number DE84006270.

From 5. international workshop on gases in strong rotation; Charlottesville, VA, USA (5 Jun 1983).

The flow field generated by a rapidly rotating centrifuge with a scoop is represented as an unsymmetrical blunt body flow. Shock wave shapes and other flow characteristics are calculated for a range of Mach numbers and angles of incidence. The change in flow pattern when UF_6 is used as the ambient gas instead of air is discussed.

8379 (CONF-830642—, pp 575-590) **Spin-up and spin-down flow in ellipsoidal cavities.** Kilgenstein, P.; Roesner, K.G. (Technische Hochschule, Darmstadt, Germany). 1983. NTIS, PC A99/MF A01. File Number DE84006270.

From 5. international workshop on gases in strong rotation; Charlottesville, VA, USA (5 Jun 1983).

The motion of a viscous liquid contained in an ellipsoidal cavity is investigated qualitatively by experiments which are based on the effect of photochromic coloring induced by an ultraviolet laser beam. The typical behavior of a time-dependent boundary layer along curved walls can be observed. Locally the growth of the boundary layer can be described theoretically by a series expansion of the field variables with respect to three-dimensional ellipsoidal coordinates. Such an expansion is performed by algebraic calculations on the computer. The zeroth-order approximation can be compared with experimental data and shows a satisfactory agreement. Experimental results are also given for the degenerate case of a spherical cavity which is stopped after having reached the rigid body rotation state. By the photochromic coloring technique details of the structure of the flow field can be analyzed. The spin-up process of a liquid body contained in an elliptical cylinder shows the formation of a shear layer instability which results in a typical structure of tracer particles which are added to the liquid. The same qualitative picture can be found for the spin-up motion in an ellipsoidal cavity.

8380 (CONF-830642—, pp 591-609) **Diffusion and flow calculations in centrifuges using full conservation equations.** Merten, A.; Haenel, D. (Uranit, Juelich, Germany; Aerodynamisches Institut, Aachen, Germany). 1983. NTIS, PC A99/MF A01. File Number DE84006270.

From 5. international workshop on gases in strong rotation; Charlottesville, VA, USA (5 Jun 1983).

The complete nonlinear and a linearized version of the conservation equations describing the flow and the diffusion in a gas centrifuge are solved numerically. For both cases an implicit approximate factorization scheme is used to integrate the equations. Results are presented according to the parameter set of the GSR Rome model centrifuge. The influences of the feed rate, the circumferential speed and the aspect ratio on the flow and diffusion are investigated.

8381 (CONF-830642—, pp 611-645) **Supersonic, rarefied gas flow past a scoop: a Monte Carlo approach.** Hausman, M.A.; Roberts, W.W. Jr. (Virginia Univ., Charlottesville). 1983. NTIS, PC A99/MF A01. File Number DE84006270. Contract AC05-82OR20900.

From 5. international workshop on gases in strong rotation; Charlottesville, VA, USA (5 Jun 1983).

We describe a Monte Carlo, N-body computer code designed to study supersonic gas flows in a rarefied, strongly stratified medium. The code is applied to the simulation of flows in gas centrifuges, in the region where the molecular mean free path is similar to the density scale height. We discuss the perturbations on a uniformly rotating gas which result when a flat, diffusely scattering plate is introduced into this region. Although our plate, which is a useful approximation to a scoop in a gas centrifuge, has its axis parallel to the incoming flow, the resulting density and velocity perturbations are not symmetric about this axis. In particular, the perturbed gas shows a strong, radially inward flow inboard and downstream of the plate, which leads to relatively high gas densities in these regions. We discuss briefly the limitations of our Monte Carlo algorithm and the possibility of experimentally testing our predictions.

8382 (CONF-830642—, pp 647-680) **Optimum position of the inner boundary of two stream profiles in gas centrifuges.** Langbein, G.M.; Shepherd, S. (Urenco Ltd., Marlow, England). 1983. NTIS, PC A99/MF A01. File Number DE84006270.

From 5. international workshop on gases in strong rotation; Charlottesville, VA, USA (5 Jun 1983).

This paper profiles the ideal boundary conditions for gas centrifuges, using mathematical models to explain the separation processes.

8383 (CONF-830642—, pp 681-707) **Monte-Carlo simulation of rarefied gas shear flow under strong rotation.** Stopford, P.J.; Williams, M.G.; Johnson, E.A. (Atomic Energy Research Establishment, Harwell, England; Surrey Univ., Guildford, England). 1983. NTIS, PC A99/MF A01. File Number DE84006270.

From 5. international workshop on gases in strong rotation; Charlottesville, VA, USA (5 Jun 1983).

The effects of rarefaction in a gas centrifuge are investigated by using a Monte-Carlo simulation method of the tracer-field type. For simplicity the problem considered is that of a single gas undergoing shear between two moving parallel plates with a centrifugal-type body force acting towards the plates - the Pomraning problem. Following a brief review of previous results for this problem the tracer-field Monte-Carlo method is described and some test calculations for collisionless flows and plane Couette flow are presented. Finally Monte-Carlo results for the Pomraning problem are compared with an analytic result for the shear velocity.

8384 (CONF-830642—, pp 709-743) **Asymptotic theory of mass transfer in a gas centrifuge for small Ekman number.** Conlisk, A.T.; Foster, M.R.; Walker, J.D.A. (Ohio State Univ., Columbus; Lehigh Univ., Bethlehem, PA). 1983. NTIS, PC A99/MF A01. File Number DE84006270.

From 5. international workshop on gases in strong rotation; Charlottesville, VA, USA (5 Jun 1983).

The fluid motion and mass transfer characteristics of a gas centrifuge are considered. The model centrifuge consists of a pair of concentric circular cylinders bounded on the top and bottom by horizontal and plates; the apparatus rotates rapidly about the axis of the cylinders. During steady operation a binary gas containing species A and B is injected into and withdrawn from the centrifuge through small axisymmetric slots located on the sidewalls and in the corner regions. Solutions for the velocity and temperature fields are obtained for both mechanically and thermally driven centrifuge. Emphasis is placed upon the mass transfer problem which is coupled to the fluid flow through the boundary conditions at the sidewalls. Separation factors are obtained as a function of cut, feed flow rate, rotational Mach number, bowl shape, and a parameter which describes the effect of the mechanical or thermal driving mechanism. The analysis is restricted to cases for which M³E much less than rho/sub R/ where M is the rotational Mach number, E is the Ekman number, and rho/sub R/ is a small density factor. Also considered is the effect of moving the feed, and waste ports.

8385 **(K/OA—2101) Theory of the gas helix.** Hoglund, R.L.; Roberts, D.J.; Von Halle, E. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 7 Mar 1972. Contract AC05-84OT21400. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004049.

The discussion of the gas helix covers the separation effect, the power requirement, the power utilization index, and the theoretical results.

0507 Fuels Production And Properties

8386 **(Juel—1871) Silicon carbide coatings of nuclear fuel particles.** Wallura, E.; Hoven, H.; Koizlik, K.; Linke, J.; Mehner, A.W. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorwerkstoffe und Heisse Zellen). Sep 1983. 66p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE85750071.

The coating layers of coated fuel particles are the most important barrier against gaseous and solid fission products generated during irradiation. Especially the SiC layer need high retention capability mainly for Ag- and Cs-isotopes and excellent mechanical performance under irradiation. So a characterization program was set up including 25 SiC-coatings deposited under different conditions, to find correlations between material parameters and fission products release properties. The results from the applied physical characterization methods are reported. However this study did not result in a material parameter of unirradiated SiC, which is correlated quantitatively with the fission product retention of the SiC coating. Nevertheless, the large amount of additional informations has improved the understanding of SiC significantly.

8387 **(Juel—1917) Irradiation behaviour of coated fuel particles for the fissile/fertile particle system.** Foerthmann, R. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorwerkstoffe und Heisse Zellen). May 1984. 104p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE85750076.

The cross evaluation of 30 irradiation experiments which were carried out in the last ten years in order to test fuel particles for the separate use of high enriched uranium in fissile particles and thorium in fertile particles, led to the following results: An oxide-based fissile/fertile particle system (UO_2 fissile kernel/ThO_2 fertile kernel) can be used as well as the American carbide/oxide particle system (UC_2 fissile kernel/ThO_2 fertile kernel) under the operation conditions of a high temperature reactor with spherical fuel elements. The swelling of fissile kernels as a consequence of fission gas pores is much more pronounced in UO_2 than in UC_2 fissile kernels but the buffer layer copes with the swelling without any problems. Ceramic kernel additives (e.g. Al_2O_3)as well as carbon additives proved not to be suitable because they deteriorate the mechanical properties of the fissile kernels. Kernel migration in a temperature gradient ('amoeba effect') is observed during irradiation of UO_2 fissile particles but this does not cause any coating failure. The amoeba effect is suppressed completely by 10% UC_2 additives to the UO_2 kernel. The silicon carbide interlayer is absolutely necessary for an efficient retention of the solid fission products and has also proved successful for fertile particles. A measurable fraction of defective particle coatings was not observed before exceeding the target values of burnup and fast neutron fluence. The irradiation-induced dimensional changes of the graphite matrix are independent of the fuel volume loading and have no influence on the irradiation behaviour of the embedded fissile and fertile particles.

0508 Spent Fuels Reprocessing

REFER ALSO TO CITATION(S) 0508008422, 8431, 8886, 8902

8388 **(KFK—3298) Report of research and development work of the Institut fuer Heisse Chemie, 1981.** (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Heisse Chemie). Feb 1982. 24p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE85750090.

The following work was carried out during 1981 at the Institute of Hot Chemistry: 1. Extraction studies with light water reactor fuels, 3. Process analysis in reprocessing, 3. Development of extraction apparatus, 4. Process conduction studies and process control, 5. Surveillance of fuel element-sheath damage and contamination, 6. Hydrolysis and radiolysis of tributyl phosphate, and 7. Water chemical studies on organic pollutants. In addition, a survey is given of publications and lectures.

8389 **(ORNL/TM—9118) Assessment of Purex solvent cleanup methods using a mixer-settler system.** Mailen, J.C.; Tallent, O.K. (Oak Ridge National Lab., TN (USA)). Nov 1984. Contract AC05-84OR21400. 59p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85003514.

A test system consisting of three mixer-settlers in series has been used to determine the usefulness of several possible aqueous scrub solutions for cleanup of TBP solvent in fuel reprocessing plants. The simulated solvent that was treated was nominally 0.1 mM zirconium, 0.2 mM uranium, 0.4 mM dibutyl phosphate, and 0.3 mM HNO_3. Five aqueous scrub solutions - sodium carbonate/tartrate, hydroxylamine/tartaric acid, hydroxylamine/citric acid, hydrazine/oxalic acid, and LiOH/sucrose - were evaluated. The order of effectiveness of these solutions for removal of contaminants was: sodium carbonate/tartrate, hydrazine/oxalic acid, LiOH/sucrose, and the two hydroxylamine solutions. Interfacial crud, which was related to the presence of zirconium and DBP, was observed in all cases except the LiOH/sucrose solution. The recommended system would use sodium carbonate/tartrate. If sodium usage must be minimized, a hydroxylamine-containing scrub followed by a sodium carbonate/tartrate scrub is recommended. 13 references, 11 figures, 21 tables.

8390 **(RFP—3556) Start-up studies for the new plutonium facility at Rocky Flats. Batch processing of plutonium nitrate.** (Rockwell International Corp., Golden, CO (USA)). 1984. Contract AC04-76DP03533. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003980.

8391 **(RFP—3567) Plutonium and americium processing chemistry and technology.** Navratil, J.D. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1984. Contract AC04-76DP03533. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003985.

Plutonium processing in the USA originated at Hanford and Los Alamos as part of the Manhattan Project in 1943. Hanford separated plutonium from irradiated reactor fuel, whereas Los Alamos purified the plutonium, as well as recovered plutonium from residues and scrap. In the early 1950's, similar processing facilities were constructed at Savannah River and Rocky Flats. The PUREX process (tri-n-butyl phosphate extraction) is used at Hanford and Savannah River plants to separate plutonium from irradiated reactor fuel. At Los Alamos and the Rocky Flats Plant (RFP), both pyrochemical and aqueous processes are used to recover and purify plutonium. A by-product in the plutonium recovery processes is americium-241 from the beta decay of plutonium-241 present in the plutonium-239 stream. An overview of the americium and plutoni-

um processing chemistry and technology at RFP is presented. 49 references, 3 figures.

8392 **(RFP—3639) Ion exchange technology in spent fuel reprocessing.** Navratil, J.D. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). [1985]. Contract AC04-76DP03533. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003967.

Solvent extraction is the major unit operation employed in spent nuclear fuel reprocessing. The operation yields three streams: fission product waste, uranium product and plutonium product. Ion exchange is primarily used in reprocessing as a tail-end method to concentrate and isolate the plutonium product stream. This chapter will describe the details of plutonium recovery and purification by both cation and anion exchange processing. A brief overview of miscellaneous uses of ion exchange employed in reprocessing will also be given. 19 references, 6 figures, 2 tables.

8393 **(RFP—3686) Review of major plutonium pyrochemical technology.** Moser, W.S.; Navratil, J.D. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1983. Contract AC04-76DP03533. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004971.

The past twenty years have seen significant growth in the development and application of pyrochemical technology for processing of plutonium. For particular feedstocks and specific applications, non-aqueous high-temperature processes offer key advantages over conventional hydrometallurgical systems. Major processes in use today include: (1) direct oxide reduction for conversion of PuO_2 to metal, (2) molten salt extraction for americium removal from plutonium, (3) molten salt electrorefining for Pu purification, and (4) hydriding to remove plutonium from host substrates. This paper reviews current major pyrochemical processes from the classical calcination-hydrofluorination-bomb reduction sequence through new techniques under development. Each process is presented and brief descriptions of production equipment are given. 47 references, 5 figures.

0509 Transport And Storage

REFER ALSO TO CITATION(S) 0509008401

8394 **(EGG-M—20184) Performance of defected spent LWR fuel rods in inert and dry air storage atmospheres.** Olsen, C.S. (EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 20p. (CONF-8410142—50). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003555.

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

This paper presents the results of the third examination conducted to determine any degradation in eight fuel rods after being subjected to 13,168 h at temperature. During this examination, visual observations, diametrical measurements, and isotopic analysis of smears were used to assess the fuel rod behavior and particulate release. The PWR fuel showed no measurable change from the pretest condition. The artificial defects had not changed and no diametrical growth in the cladding occurred. A BWR fuel rod replaced one that breached after the second interim examination, and a 1.9 cm crack developed in this rod at the bottom defect. About 17% cladding deformation was observed at the defect. Minute amounts of crud consisting of the cobalt-60 isotope fell into the fuel rod capsules. A slight amount of fuel (0.1 g) from the breached BWR fuel rod was found in the capsule. The BWR fuel rod removed after the second interim examination was destructively examined. The fuel was oxidized to U_3O_8 in the area of the cladding defect. The extent of oxidation decreased further away from the breach, also corresponding to smaller cladding deformation. The extensive fuel oxidation may result from intergranular diffusion of oxygen through the open porosity. Release of fission gases in a sealed fuel rod capsule may also be attributed to fuel oxidation along grain boundaries which are open. Results of the testing with the BWR fuel indicate that dry storage above 490 to 502°K is not acceptable for this particular fuel used. This fuel may be atypical of current fuel design and fabrication techniques. The BWR results may not be applicable to PWR fuel because of the wide differences observed between PWR and BWR fuel rod behavior. The PWR fuel rods are being destructively examined to determine the extent of oxidation, but additional effort is required to determine oxidation mechanisms and identify the causes of the differences in behavior between PWR and BWR fuel.

8395 **(EPRI-NP—3765) Surveillance of LWR spent fuel in wet storage. Final report, October 1984.** Bailey, W.J.; Johnson, A.B. Jr. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Oct 1984. Contract AC06-76RL01830. 95p. NTIS, PC A05/MF A01 - EPRI; GPO Dep. File Number DE85003685.

Battelle, Pacific Northwest Laboratories established a surveillance program for EPRI that documents the integrity of spent light-water reactor fuel and structural materials (spent fuel storage pool liners, racks, piping, etc.) during wet storage. The program involves providing an update on the overall performance of spent fuel in wet storage, monitoring Licensee Event Reports (LERs) for pertinent significant occurrences, identifying lead spent fuel assemblies that are of particular interest to EPRI, monitoring developments in fuel design and performance and assessing their influence on spent fuel storage characteristics, and identifying specific actions or programs that may be needed to maintain the viability of wet storage of spent fuel for extended periods. Experience to date indicates that wet storage is a well-developed technology with no associated major technological problems. Spent fuel storage pools are operated without substantial risk to the public or the plant personnel. A list of lead spent fuel assemblies is presented. Pertinent occurrences from LERs are listed. Very few fuel assemblies have suffered major mechanical damage as a result of handling operations at spent fuel storage pools. Experience to date with handling operations at spent fuel storage pools indicates that failed fuel rods and inadvertent fracturing of fuel rods can be accommodated. Minor problems have occurred with spent fuel storage pool components such as liners, racks, and piping. Surveillance continues to be needed on: (1) possible effects on handling and storage of spent fuel from extended burnup, hydrogen injection at boiling water reactors, and rod consolidation operations; (2) extended pool exposure of neutron-absorbing materials; (3) cracking of spent fuel storage pool piping at pressurized water reactors; and (4) control of impurities in spent fuel pool waters. 120 references, 13 figures, 10 tables.

8396 **(RFP—3552) Planning a transportation system for US Defense Transuranic waste.** Gilbert, K.V.; Hurley, J.D.; Smith, L.J.; McFadden, M.H.; Raudenbush, M.H.; Fedie, M.L. (Rockwell International Corp., Golden, CO (USA). Transuranic Waste Systems Office; USDOE Albuquerque Operations Office, NM; Stoller (S.M.) Corp., Boulder, CO (USA)). May 1983. Contract AC04-76DP03533. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004099.

The development and planning of a transportation system for US Department of Energy (USDOE) Defense Transuranic (TRU) waste has required the talents and expertise of many people. Coordination activities, design activities, fabrication, research and development, operations, and transportation are but a few of the areas around which this system is built. Due to the large number of organizations, regulations and personalities the planning task becomes extremely complex. The intent of this paper is to discuss the steps taken in planning this system, to identify the various organizations around which this system is designed, and to discuss program progress to date, scheduling, and future plans. 9 figures, 1 table.

8397 **(RFP—3731) On-site transportation of radioactive and other hazardous materials at Rocky Flats.** Krieg, D.M.; DelPizzo, R.G. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 11 Sep 1984. Contract AC04-76DP03533. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004044.

An On-Site Transportation Manual provides management and employees with regulations and instructions concerning the packaging and shipping of radioactive and other hazardous materials on the Plant site.

0520 Waste Management

REFER ALSO TO CITATION(S) 0520008414, 8415, 8416, 8420, 8421, 8822, 8902, 9119

8398 (CONF-8409115—18) Shallow land burial technology: humid. Davis, E.C.; Yeh, G.T. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 20p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004432.

From 6. annual Low-Level Waste Management Program participants' information meeting; Denver, CO, USA (11 Sep 1984). Environmental Services Division Publication No. 2434.

Applying engineered modifications to present shallow land burial (SLB) practices is one method of ensuring safe operation and improving overall disposal-site performance. Two such engineered modifications, trench lining and grouting, are being demonstrated and evaluated at the Oak Ridge National Laboratory (ORNL) Engineered Test Facility (ETF), using nine 28-m^3 experimental trenches containing compacted low-level waste (LLW). Concurrent to this field demonstration experiment, two finite-element hydrologic models have been developed to model water movement and solute transport at a waste disposal site. This paper covers progress made in these two areas during FY 1984. Though the economic analysis of the two trench treatments favored Hypalon lining (lining costs were 33% lower at this demonstration scale), results of field experiments examining waste hydrologic isolation favored the cement-bentonite grout treatment. Data from water pump-out and water pump-in tests, combined with observed intratrench water-level fluctuations, suggest that the original goal of constructing watertight liners in three experimental trenches was not achieved. In addition, trench-cover subsidence of ~ 2% of the total trench depth has been measured over two of the three lined trenches but has not occurred over any of the three grouted or three control (untreated) trenches. The evaluation of the two trench treatments is continuing. However, results indicate that the cement-bentonite treatment, implemented at a cost of \$160/m^3 of grout, provides a degree of waste isolation not afforded by the lined and control trenches and should be considered for use at SLB sites with water-related problems. 11 references, 6 figures, 2 tables.

8399 (DOE/NE—0025/3) Uranium Mill Tailings Remedial Action Program. Annual status report. (USDOE Assistant Secretary for Nuclear Energy, Washington, DC. Office of Terminal Waste Disposal and Remedial Action). Dec 1984. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004047.

The Uranium Mill Tailings Remedial Action (UMTRA) Project FY 1984 major accomplishments are summarized. Twenty-five percent of the processing site remedial actions at Canonsburg, PA, were completed. Remedial action on 118 vicinity properties at four designated locations were initiated and survey and inclusion activities on a total of 420 vicinity properties were completed. The Environmental Impact Statement (EIS) for Salt Lake City, UT, and the Environmental Assessment (EA) for Shiprock, NM were published, and the preliminary draft EIS for Durango, CO, was prepared. Remedial Action Plans (RAPs) for Salt Lake City, UT, and Shiprock, NM were completed, and draft RAPs for Gunnison, CO, and Riverton, WY were prepared. Cooperative agreements with Oregon, Wyoming, and South Dakota were executed, and the Utah cooperative agreement was modified to assign the construction management responsibility to the state. An Interagency Agreement with TVA for disposal of the Edgemont vicinity property material was executed.

8400 (DOE/PR/93000—T1) Radioactive wastes at the Hanford Reservation: a technical review. Pomeroy, J.H. (ed.). (National Academy of Sciences, Washington, DC (USA). Commission on Natural Resources). 1978. Contract AM01-76PR93000. 284p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE85003336.

This report is a review of the scientific and technological aspects of the management of radioactive wastes at the Hanford Reservation in southeastern Washington. Chapters are devoted to the following: radiation hazards from Hanford wastes; high-level wastes; low-level wastes; monitoring; possible effects of accidents sabotage, or climatic or geologic changes; and alternatives for long-term disposal.

8401 (EPRI-NP—3680) Proceedings: 1984 ASME-EPRI radwaste workshop. Coplan, B.V. (ed.). (BVC Consultants, Inc., Sun City Center, FL (USA)). Sep 1984. 137p. (CONF-840172—). Research Reports Center, Box 50490, Palo Alto, CA 94303 \$14.50. File Number TI85920004.

From ASME-EPRI radwaste workshop; Chattanooga, TN, USA (29 Jan 1984).

The proceedings of the sixth ASME-EPRI jointly sponsored Radwaste workshop are presented. The theme of this year's workshop was Technological Changes and Radwaste Organization. Presentations and discussions sessions were organized for the following topics: Compliance with 10 CFR 61 Sampling Requirements; Radwaste Training and Organization; and Radwaste Equipment and Process Update. Presentation were also made on the status of ongoing regulatory actions on LLW state compacts, DOT regulations and deminimis quantity. Individual papers are indexed for inclusion in the Energy Data Base.

8402 (Juel-Spez—226) Properties of container and backfill materials for the final disposal of highly radioactive fission products. Mirschinka, V. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Chemische Technologie der Nuklearen Entsorgung; Technische Hochschule Aachen (Germany, F.R.)). Nov 1983. 103p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE85750080.

The qualifications of six metallic alloys to serve as canister materials for an in-can glass smelting process were studied. These alloys are: N_8 1.4864 (X 12NiCrSi3616, Thermax 16/36), No. 2.4816 (NiCr15Fe, Inconel 600), No. 2.4610 (Hastelloy C4), No. 2.4778 (UMCO50), No. 1.5415 (15MO3), No. 1.1005 (ZSH-Spezial). The mechanical properties of any of the six materials at high temperatures were found to be sufficient. The chemical interactions between glass and metal were investigated by glass smelting tests and electron microprobe analyses, showing that chromium as an alloying element of the crucible material may affect the quality of the glass product by causing inhomogeneities and a violent blistering in the glass matrix. The resistance against corrosion by concentrated salt solutions under elevated pressure and temperature similar to final depository conditions was tested showing that the presence of a bentonite suspension in the salt solution reduces the corrosion attack of the metal significantly. Diffusion experiments of salt solutions doted with radioactive isotopes Na-22 and Cl-36 as tracer substances were made to show the retardation behaviour of salt ions in compacted bentonite. However, a long-term barrier effect of the bentonite against salt ion diffusion could not be verified.

8403 (KFK—3490) Report on research and development work 1982 of the Institut fuer Nukleare Entsorgungstechnik. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Entsorgungstechnik). Feb 1983. 43p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE85750097.

The R and D work carried out at the Institute of Nuclear Waste Processing during 1982 under the four sections Chemistry, Processing Technology, Final Storage, and Infrastructure and Analysis is reported here. Areas of emphasis were: 1) Development and demonstration of a technical process for embedding highly radioactive solutions of fission products in borosilicate glass blocks, 2) Study of the properties of original glass moulds produced in this process, 3) Solidification of low and medium-active waste concentrates in cement, 4) Separation of actinides and fission products from medium-active waste solutions, 5) Solidification of alpha-containing concentrates in a ceramic matrix and characterization of the products, 6) Demonstration of wet chemical oxidation of combustible wastes containing higher levels of Pu together with the recovery of Pu, 7) Investigation of the release of radionuclides from medium-active waste products by leaching, corrosion, and mechanical or thermal stress, 8) Studies on the development of long-term stable containers suitable for final storage of highly radioactive glass products in salt, 9) Studies on the storage of heat-generating waste in salt, 10) Studies on analytical safety assurance for final storage in geological formations.

8404 **(KFK—3692) Report on research and development work 1983 of the Institut fuer Nukleare Entsorgungstechnik.** (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Entsorgungstechnik). Feb 1984. 36p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE85750095.

The Institute for Nuclear Waste Processing undertook research and development work on the following key topics: 1) Inactive operation of the vitrification plant VA-3 to the point of transferal of the ceramic smelting apparatus K-3 together with other process components to the project PAMELA; 2) Active operational start-up of the facility for wet ashing Pu-waste (ALONA) in Mol, including the recovery of plutonium; 3) Study of properties of vitrified products of this technical process; 4) Laboratory trials on the separation of actinides and fission products from medium-level radioactive waste solutions; 5) Solidification of alpha-containing concentrates in a ceramic matrix, characterization of the products and process developmental work; 6) Study of the release of radionuclides from medium-level radioactive waste solutions by leaching and mechanical or thermal stress; 7) Development of stable containers for the final storage of highly radioactive vitrified products in salt; 8) Studies on analytical safety assurance for final storage in geological formations. A list of publications and lectures given by members of the Institute during 1983 is appended to the report.

8405 **(KFK—3790) Model calculations of stresses and deformations in rock salt in the near field of heated boreholes.** Pudewills, A. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Entsorgungstechnik). Aug 1984. 33p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number TI85750476.

With the help of the finite element computer code ADINA thermally induced borehole closure and stress distribution in the salt were investigated by the example of the 'Temperature Test 3' performed in the Asse mine during which the temperature and the borehole closure were measured. The aim of the calculations has been the assessment of the capabilities of the ADINA code to solve complex thermomechanical problems and to verify the available thermomechanical material laws for rock salt. In these computations the modulus of elasticity and the creep law of salt were varied in order to assess the influence exerted by these material parameters. The computed borehole closures are in good agreement with the measured data. In second part the model computations of thermomechanical phenomena around a 300 m deep borehole are presented for a HLW repository with and without brine, respectively. The finite element investigations are carried out for a periodical and symmetrical disposal field configuration with an equivalent radius of 28 m of the cylindrical unit cell. The initial state of stress was assumed to be lithostatic. A hydrostatic fluid pressure of 12 MPa was chosen for the case of accidental flooding of the repository field shortly after emplacement of the waste canisters. The essential results of this thermomechanical analysis are the borehole closure and the stresses in rock salt in the near field of the repository borehole.

8406 **(NUREG/CR—3890) Technology for uranium mill ponds using geomembranes.** Mitchell, D.H. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1984. Contract AC06-76RL01830. 86p. (PNL—5164). NTIS, PC A05/MF A01 - GPO $4.50. File Number TI85003889.

Pacific Northwest Laboratory has analyzed the performance of polymeric membrane-lined impoundments containing tailings and leachate at active uranium mills. The US Nuclear Regulatory Commission has requested this information to support licensing of impoundments. Data on the performance of lined ponds in the US uranium industry, mechanisms for damage of liners, and design, installation, and inspection practices are presented in this report. Design, construction, and inspection methods that are capable of minimizing failures are also identified. No cases of contaminated groundwater are attributed to uranium mill ponds lined with polymeric membranes (geomembranes) in the US. The leading causes of geomembrane problems for all industrial pond applications are faulty seams, puncture and errors during placement, improper connections to submerged structures, puncture by soils in contact with the geomembrane, and geotechnical problems due to liquids in the support soil. Although some instances of liner problems with potential for significant consequences have been identified, the concensus of mill operators and regulatory personnel is that performance of ponds with geomembranes in the US uranium industry has been satisfactory. 49 references, 15 figures, 10 tables.

8407 **(ONWI—117) Gulf Coast salt domes geologic area characterization report introduction. Volume I.** (Law Engineering Testing Co., Marietta, GA (USA)). Jul 1982. Contract AC06-76RL01830. 296p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE85004161.

This volume introduces Geologic Area Characterization Reports (ACRs) for the Gulf Interior Region Salt Domes. Overviews of the National Waste Terminal Storage Program and the Site Screening Process are presented. This volume also summarizes the regional geologic setting and presents a condensed review of the findings of area-phase investigations. 28 references, 48 figures, 21 tables.

8408 **(PB—85-101111/XAD) Development of calculating procedures and the execution of model calculations for the thermo-mechanical alternate effect of salt with the lining of drill holes or with stored waste blocks.** Pudewills, A.; Korthaus, E. (Commission of the European Communities, Luxembourg). [1984]. 254p. (In German). (EUR—8812-DE). NTIS, PC E11/MF E11.

It was the aim of the studies to develop thermo-mechanical calculating models and procedures for the analysis of stresses and distortions which can be expected in the proximity of stored highly radioactive waste blocks. With the aid of the ADINA program calculations for the testing and application of the evaluation of the experiments (for instance TV3, simulation experiment, standard probe) were carried out, at the same time investigating the sensitivity of the calculation results with regard to the variation of different parameters of material law, together with the effect of conditions of stress at the edge of the sample. Moreover, model calculations were carried out for the investigation of fields of stress and distortion in mineral salt in the environment of a HAW drilling site. Finally, the thermo-mechanical stress and distortion of the system salt deposit, surrounding and covering rock were analyzed on final storage variants for spent fuel elements, using simple models.

8409 **(RFP—3595) Low-level nitrate waste process development.** Meile, L.J.; Johnson, A.J. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). [1984]. Contract AC04-76DP03533. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003896.

Chemical methods of denitrification of simulated low-level nitrate wastes were investigated on a laboratory scale. Various reducing agents and catalysts were tested in evapcration and drving experiments to determine denitrification efficiency, NO/sub x/ offgas generation, and future process applicability. A peer review was conducted to gain input on processing needs and preferences from actual nitrate waste generators. Experimental results are discussed and conclusions presented. 10 tables.

8410 **(RFP—3620) Immobilization of Rocky Flats Plant liquid organic wastes.** Wrobel, S.J. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 17 Oct 1983. Contract AC04-76DP03533. 21p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003917.

This study concerns the solidification of low-level and transuranic (TRU) liquid organic wastes produced during normal operations at the Rocky Flats Plant. Its purpose was to determine an acceptable and cost effective method for immobilizing liquid organic wastes. Envirostone gypsum cement; Portland cement; Portland cement with Oil Dri absorbent; Envirostone with Portland cement; and Envirostone with Oil Dri absorbent were investigated for their suitability in producing waste forms in compliance with all TRU waste acceptance criteria for the Waste Isolation Pilot Plant (WIPP) as specified in WIPP-DOE-114. Evaluation of the various solidification media was based on suitability for immobilizing organic wastes, waste loading efficiency, required set-time, and cost of production scale operation. The production scale operation costs included materials, packaging, shipping, and storage. The study indicates that Envirostone gypsum cement is most applicable to the or-

ganic wastes generated at Rocky Flats Plant. Envirostone provides a solid, homogeneous cast absent of free liquids while achieving waste loading efficiencies of up to 50 vol %. The yearly production scale costs for solidification with Envirostone would amount to about $265,000.

8411 **(SAND—84-1145C) Ion implantation damage processes in nuclear waste glass and other silicate glasses.** Arnold, G.W. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 7p. (CONF-841157—26). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004170.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1984).

Cantilever beam measurements of induced lateral stress have been made for He, Xe and Pb ion-implantation into the complex borosilicate radioactive waste glasses (PNL 76-68, SRP), a commercial borosilicate (Pyrex), and into fused SiO_2 (Suprasil 1). For the borosilicate glasses, implantation caused a buildup of stress to a saturation value ($\sim 1 \times 10^8$ dynes/cm). The maximum occurred at ion fluences greater than those found for maximum stress in fused silica and without a stress relief mechanism. The separate family of stress curves for Pyrex and PNL 76-68 coincide when stress is plotted as a function of energy into electronic processes. Pyrex has 13 wgt.% B_2O_3 and 81 wgt.% SiO_2, while PNL 76-68 and SRP have 10% B_2O_3, 40% SiO_2 and 15% B_2O_3 and 58% SiO_2, respectively. Pyrex is known to be phase-separated, and the waste glasses are susceptible to phase separation. It is suggested that the B_2O_3 phase may be more easily compacted than the SiO_2 phase. The evidently greater effectiveness of the ionization component of the ion energy in creating damage in borosilicate glasses should be of considerable interest in waste glass studies because of the large amounts of ionization from α-decay ($\sim$ 5 MeV He).

8412 **(UCID—20276) LLNL radioactive waste management plan as per DOE Order 5820.2.** (Lawrence Livermore National Lab., CA (USA)). 10 Dec 1984. Contract W-7405-ENG-48. 156p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85004633.

The following aspects of LLNL's radioactive waste management plan are discussed: program administration; description of waste generating processes; radioactive waste collection, treatment, and disposal; sanitary waste management; site 300 operations; schedules and major milestones for waste management activities; and environmental monitoring programs (sampling and analysis).

8413 **(UCRL—90853) Hydrothermal interaction of Topopah Spring tuff with J-13 water as a function of temperature.** Knauss, K.G.; Delany, J.M.; Beiriger, W.J.; Peifer, D.W. (Lawrence Livermore National Lab., CA (USA)). 30 Nov 1984. Contract W-7405-ENG-48. 9p. (CONF-841157—25). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004412.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1984).

In support of the Nevada Nuclear Waste Storage Investigations Project experiments were conducted to study the hydrothermal interaction of rock and water representative of a potential repository in tuff. These experiments provided data relevant to near-field repository conditions that can be used to: assess the ability to use accelerated tests based on the SA/V (surface area/volume) parameter and temperature; allow the measurement of chemical changes in phases present in the tuff before reaction as well as the identification and chemical analysis of secondary phases resulting from hydrothermal reactions; and demonstrate the usefulness of geochemical modeling in a repository environment using the EQ3/6 thermodynamic/kinetic geochemical modeling code. Crushed tuff and polished wafers of tuff were reacted with a natural ground water in Dickson-type gold-cell rocking autoclaves which were periodically sampled under in-situ conditions. Results were compared with predictions based on the EQ3/6 geochemical modeling code. Eight short-term experiments (2 to 3 months) at 150°C and 250°C have been completed using tuff from both drillcore and outcrop. Long-term experiments at 90°C and 150°C using drillcore polished wafers are in progress. This paper will focus on the results of the 150°C and 250°C experiments using drill core polished wafers. 11 references, 4 figures.

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 0530008398, 8406, 9119

8414 **(AECL—7818) Behaviour of radium in soil and in uranium mine-tailings.** Shoesmith, D.W. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Sep 1984. 75p. Scientific Documentation Office-AECL, Chalk River, Ontario, Canada $5.00. File Number TI85900378.

Work performed under Canada/US Waste Management Information Exchange Agreement.

The existence of a number of historical wastes has prompted the need to develop a disposal strategy for material contaminated with radium-226. This report reviews the pertinent radiological and chemical properties of radium, in particular, the solubility of its salts, its ability to complex, its adsorption behavior, and how these properties compare with those of the other members of the alkaline earth series. Chemical factors that determine the mobility of radium in soil/groundwater environments are discussed. Adsorption on clays, minerals and organic matter, and coprecipitation are the main processes that inhibit radium mobility. Soil leaching studies are reviewed. The largest potential source of radium in the environment is the leaching of uranium mine-tailings. Hence the mineralogy of mine-tailings and attempts to leach them are reviewed. Radium levels in leached residues are compared to the standards for radium levels, and realistic targets are suggested for leaching methods. Techniques for scrubbing soil, immobilizing radium, and treating wastewater containing radium are reviewed. Finally, recommendations are made for a possible leaching strategy for radium-contaminated soil, and for further research to develop an effective disposal strategy. 118 references, 3 figures, 13 tables.

8415 **(DOE/EIS—0111D-Vol.1) Remedial actions at the former Vanadium Corporation of America uranium mill site, Durango, La Plata County, Colorado. Draft environmental impact statement. Volume I. Text.** (USDOE Albuquerque Operations Office, NM). Oct 1984. 256p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE85003943.

This statement evaluates the environmental impacts associated with the remedial actions of the residual radioactive materials remaining at the inactive uranium processing site located in Durango, La Plata County, Colorado. The site is a 126-acre tract of privately owned land which contains about 1.6 million cubic yards of contaminated materials including 1.2 million cubic yards of uranium and vanadium tailings. The tailings were produced by the former United States Vanadium Corporation from 1943 to 1946, and by the Vanadium Corporation from 1943 to 1946, and by the Vanadium Corporation of America from 1949 to 1963. Vanadium tailings and uranium ore were processed for sale to the US Atomic Energy Commission until the mill was closed in 1963. Five alternatives are considered in this statement. These alternatives are (1) no action, (2) stabilize the contaminated materials on the Durango site, (3) transport the contaminated materials to the Bodo Canyon site for disposal and decontaminate the Durango site, (4) transport the contaminated materials to the Long Hollow site for disposal and decontaminate the Durango site, and (5) transport, reprocess, and dispose of the tailings at the Long Hollow site and decontaminate the Durango site. An assessment of the impacts of these five alternatives was made in terms of effects on radiation levels, air quality, soils and mineral resources, surface- and ground-water resources, populations and employment, economic structures, and transportation networks. A summary table of the impacts is given.

8416 **(DOE/EIS—0111D-Vol.2) Remedial actions at the former Vanadium Corporation of America uranium mill site, Durango, La Plata County, Colorado. Draft environmental impact statement. Volume II. Appendices.** (USDOE Albuquerque Operations Office, NM). Oct 1984. 614p. NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE85003947.

Volume II contains the following appendices: conceptual designs and engineering evaluations for remedial alternatives; vicinity-property remedial actions; alternatives that were considered but rejected; meteorological and air-quality information; soils, geologic, and seismic information; water resources information; ecological in-

formation; radiological information; information on populations, socioeconomics, and land use; floodplain and wetlands assessment; and list of agencies, organizations, and persons receiving copies of this statement.

8417 **(GAT-T—3282) Continuous vent sampler for monitoring radionuclide emissions.** Orlett, M.J. (Goodyear Atomic Corp., Piketon, OH (USA). Chemical and Materials Technology Dept.). 19 Oct 1984. Contract AC05-76OR00001. 15p. (CONF-841187—15). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003686.

From 5. DOE environmental protection information meeting; Albuquerque, NM, USA (6 Nov 1984).

A prototype continuous vent gas sampler for monitoring uranium and technetium emissions from the Portsmouth Gaseous Diffusion Plant has been developed and extensively tested. Based on the results of laboratory tests and field use, a sampler of the prototype design will provide: acceptable accuracy for the continuous and automatic sampling of radionuclide emissions for vent monitoring purpose; capability to significantly extend detection limits for uranium and ^{99}Tc concentrations in plant vent gases using existing, well-established analytical methods; and reliable operation and minimal maintenance. In addition, the continuous sampler is an attractive alternative to replace grab sampling since it: offers a potential cost savings estimated at 200K/year; allows more convenient storage of samples for archival purposes and retrieval, if necessary; and is a more flexible means of meeting alternative monitoring needs with the requisite accuracy and frequency of results. Design criteria have been established by this work and are being used for engineering continuous samplers for permanent installations. 3 references, 3 figures, 3 tables.

8418 **(NUREG/CR—3738) Environmental effects of the uranium fuel cycle: a review of data for technetium.** Till, J.E.; Shor, R.W.; Hoffman, F.O. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 126p. (ORNL/TM—9150). NTIS, PC A07/MF A01 - GPO. File Number TI84016808.

Sources of potential releases of ^{99}Tc to the environment are reviewed for the uranium fuel cycle considering two options: the recycle of spent uranium fuel and no fuel recycling. In the no recycle option, the only source of ^{99}Tc release is an extremely small amount associated with airborne emissions from the processing of high-level wastes. With recycling, ^{99}Tc releases are associated with the operation of reprocessing facilities, UF_6 conversion plants, uranium enrichment plants, fuel fabrication facilities, and low- and high-level waste processing and storage facilities. Among these, the most prominent ^{99}Tc releases are from the liquid effluents of uranium enrichment facilities (0.22 Ci per reference reactor year). A review of parameters of importance for predicting the environmental behavior and fate of ^{99}Tc indicates a substantial reduction from earlier estimates of the radiological significance of exposure pathways involving the ingestion of milk and meat. More important routes of exposure to ^{99}Tc will probably be associated with drinking water and the consumption of aquatic organisms, garden vegetables, and eggs. For each parameter reviewed in this study, a range of values is recommended for radiological assessment calculations. Where obvious discrepancies exist between these ranges and the default values listed in USNRC Regulatory Guide 1.109, consideration for revision of the USNRC default values is recommended.

8419 **(PB—85-101210/XAD) Economic impact of proposed regulation R82-2: atomic radiation regulations. Final report.** (RCF, Inc., Chicago, IL (USA)). Oct 1983. 127p. NTIS, PC A07/MF A01.

This study estimates the economic impacts of the proposed Illinois Pollution Control Board regulation concerning radioactive air emissions (Docket R82-2). The proposed regulation specifies standards, record keeping, monitoring, and notification requirements that are very similar to federal regulations currently administered by the Nuclear Regulatory Commission. Firms and other organizations in Illinois affected by the proposed regulation were identified. These facilities include thirteen nuclear power reactors currently operating or under construction, a spent fuel repository, a uranium hexafluoride manufacturing plant, three university and training reactors, radiopharmaceutical manufacturers, and several major hospitals. The costs to government in Illinois of enforcing these regulations were estimated. On the benefit side, an increase in safety implies a possible reduction in population exposure to radioactive emissions. These reductions in radiation exposure were translated into reductions in deaths from cancer, which is the primary health effect of radiation exposure.

8420 **(PNL—5015-3) Uranium recovery research sponsored by the Nuclear Regulatory Commission at Pacific Northwest Laboratory. Quarterly progress report, April-June 1984.** Foley, M.G.; Deutsch, W.J.; Gee, G.W.; Hartley, J.N.; Kalkwarf, D.R.; Fayer, M.J.; Nelson, R.W.; Opitz, B.E.; Peterson, S.R.; Serne, R.J. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1984. Contract AC06-76RL01830. 33p. NTIS, PC A03/MF A01; GPO Dep. File Number DE84017024.

Progress is reported on the following studies dealing with mill tailings: long-term stabilization; interim stabilization of mill tailings piles; tailings dewatering techniques; tailings neutralization and other alternatives in immobilizing toxic materials in tailings; evaluation of seepage and leachate transport from tailings disposal facilities; effluent and environmental monitoring methods and equipment and instrument testing; attenuation of radon emissions; assessment of leachate movement from uranium mill tailings; and methods of minimizing ground water contamination in in-situ leach uranium mining. 1 figure.

8421 **(PNL—5177) Arid site water balance: evapotranspiration modeling and measurements.** Gee, G.W.; Kirkham, R.R. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1984. Contract AC06-76RL01830. 52p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85003090.

In order to evaluate the magnitude of radionuclide transport at an aird site, a field and modeling study was conducted to measure and predict water movement under vegetated and bare soil conditions. Significant quantities of water were found to move below the roo of a shallow-rooted grass-covered area during wet years at the Hanford site. The unsaturated water flow model, UNSAT-1D, was resonably successful in simulating the transient behavior of the water balance at this site. The effects of layered soils on water balance were demonstrated using the model. Models used to evaluate water balance in arid regions should not rely on annual averages and assume that all precipitation is removed by evapotranspiration. The potential for drainage at arid sites exists under conditions where shallow rooted plants grow on coarse textured soils. This condition was observed at our study site at Hanford. Neutron probe data collected on a cheatgrass community at the Hanford site during a wet year indicated that over 5 cm of water drained below the 3.5-m depth. The unsaturated water flow model, UNSAT-1D, predicted water drainage of about 5 cm (single layer, 10 months) and 3.5 cm (two layers, 12 months) for the same time period. Additional field measurements of hydraulic conductivity will likely improve the drainage estimate made by UNSAT-1D. Additional information describing cheatgrass growth and water use at the grass site could improve model predictions of sink terms and subsequent calculations of water storage within the rooting zone. In arid areas where the major part of the annual precipitation occurs during months with low average potential evapotranspiration and where soils are vegetated but are coarse textured and well drained, significant drainage can occur. 31 references, 18 figures, 1 table.

8422 **(WINCO—1018) Baseline levels of controlled pollutants in the vicinity of ICPP processes.** Adamic, M.L.; Burr, J.R.; McManus, G.J. (Westinghouse Idaho Nuclear Co., Inc., Idaho Falls (USA)). Sep 1984. Contract AC07-84ID12435. 61p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85004644.

This report documents the basic research performed in FY-1984 that will be required to establish ICPP compliance with environmental regulations (such as the Clean Air Act, EPA UIC limits, and DOE orders) when new processes are brought on-line, new fuel types are processed, and new waste management activities are started. Background ambient air concentrations of H_2S, SO_2, total suspended particulates, non-methane hydrocarbons, and particulate

cadmium and mercury are documented. Mercury, cadmium, and sulfide levels and the pH of ICPP precipitation were determined. Cadmium and mercury concentrations in the ICPP soils are also documented. 13 references, 12 figures, 11 tables.

0540 Health And Safety

REFER ALSO TO CITATION(S) 0540008399, 8415, 8416, 9095, 9111

8423 (LA-UR—84-3528) Los Alamos National Laboratory's environmental surveillance and radiological emergency vehicle and the Co-60 incident. Van Etten, D.M.; Ahlquist, A.J.; Hansen, W.R. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 7p. (CONF-841187—16). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003729.

From 5. DOE environmental protection information meeting; Albuquerque, NM, USA (6 Nov 1984).

A 4-wheel drive van has been outfitted at Los Alamos for environmental surveillance and radiological emergencies. The van's capabilities were described at this conference in 1982. The rapid gamma search and spectral analysis capabilities were utilized in conjunction with the cobalt-60 (^{60}Co) teletherapy source incident in Juarez, Mexico. Assistance was requested by the State of New Mexico (through DOE/Albuquerque Area Office) in January 1984 to perform initial in-situ isotopic identification of the contaminated steel that was first discovered in the United States by Los Alamos. The van's capabilities were again called upon in March 1984 to survey the New Mexico highways using the highly sensitive delta count rate monitoring system for ^{60}Co pellets that may have been tracked into the state. This paper provides (1) setup and results of the surveys conducted with the van, (2) interactions with the press, and (3) an evaluation of the van's usefulness in such an emergency response. 2 references, 5 figures.

0550 Regulations

REFER ALSO TO CITATION(S) 0550008883, 8885, 8886, 8902

8424 (KFK—3700) Research and development work carried out in 1983 by the Enticklungsabteilung Kernmaterialsicherung. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Entwicklungsabteilung Kernmaterialsicherung). Feb 1984. 9p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number TI85750484.

In 1983, activities focused on: ways of updating the nuclear materials balance, in particular as to its applicability in large reprocessing plants; evaluation of safeguard systems and optimum employment of inspectors by the monitoring authority; final functional tests of a camera system to be used by the IAEA; final measurements at personnel airlocks for the detection of misappropriated nuclear materials; evaluation of the IDA-80 interlaboratory test and summary of provisional results for the participants.

8425 (LA—10170-PR) Safeguards and security progress report, January-December 1983. Smith, D.B. (comp.). (Los Alamos National Lab., NM (USA)). Sep 1984. Contract W-7405-ENG-36. 87p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85004488.

From January to December 1983, the Los Alamos Safeguards and Security Program was involved in the activities described in the first four parts of this report: Nuclear Facility Support, Security Development and Support, Safeguards Technology Development, and International Safeguards. Part 1 covers efforts of direct assistance to the Department of Energy (DOE) and Nuclear Regulatory Commission (NRC) licensee facilities. This assistance includes consultation on materials accounting problems, development of specialized techniques and instruments, and comprehensive participation in the design and implementation of advanced safeguards systems. In addition, a series of training courses in various aspects of safeguards makes the technology more accessible to those who must apply it. Part 2 treats activities aimed at the security of information and computer systems. Our focus this peiod was on continuing the activities of the Computer Security Center, which provides the basis for encouraging and disseminating this emerging technology, and on the development and demonstration of secure computer systems. Part 3 describes the broad development efforts essential to continuing improvements in the practice of safeguards. Although these projects are properly classified as developmental, they address recognized problems that commonly occur in operating facilities. Finally, Part 4 covers international safeguards activities, including both support to the International Atomic Energy Agency and bilateral exchanges. Enrichment plant safeguards, especially those concerning the Gas Centrifuge Enrichment Plant, required a significant portion of our resources. These efforts are beginning to provide substantial returns on our investment in technology transfer, not only in raising the level of safeguards effectiveness but also in our benefiting from field experiences in operating environments.

8426 (NUREG/CR—0200-Vols.1,2,3) SCALE: a modular code system for performing standardized computer analyses for licensing evaluation. Revisions and errata sheets for Volumes 1, 2, 3. (Oak Ridge National Lab., TN (USA)). Dec 1984. Contract AC05-84OR21400. 821p. (ORNL/NUREG/CSD—2/R3). NTIS, PC E20/MF $7.50 - GPO. File Number TI85004154.

Includes 10 sheets of 48x reduction microfiche.

The enclosed documentation material is required to update previously published SCALE documentation to make the Manual consistent with the latest publicly released version of SCALE, called SCALE-3. The pages have been placed in order of their correct sequential appearance in the Manual and should replace the corresponding pages or sections from previous releases. Besides the revised master Table of Contents, this material includes a Foreword, a List of Revisions (providing publication dates and revision dates for all parts of NUREG/CR-0200), corrected and revised pages necessary to update the various sections of the Manual to the SCALE-3 version, and completely revised documentation for KENO V and JUNEBUG which have been updated to KENO V.a and JUNEBUG-II. The existing tabs provided with earlier releases can still be used with these revised sections. KENO V.a provides significantly improved geometric modeling capabilities over KENO V while JUNEBUG-II is an improved and more efficient version of the existing three-dimensional MARS plotting package. The revised pages reflect (1) changes to CSAS4 to allow interfacing with KENO V.a and add two new analytic sequences, (2) changes to HTAS1 to update the defaults to 10CFR71 and add plotting capabilities, (3) changes to ORIGEN-S to add an improved evaluation of the neutron source, an evaluation of a neutron spectrum, and to allow data output for subsequent plotting, (4) changes to MORSE-SGC/S and MARS to improve tracking efficiency and correct known errors, and (5) addition of several materials to the Standard Composition Library.

8427 (RFP—3571) Application of a pulsed sonic liquid level device to chemical processing tanks. Haupt, M.L.; Johnson, C.M. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). [1984]. Contract AC04-76DP03533. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003963.

The ever increasing concern over safeguards and accountability of nuclear material has prompted the need for a more accurate and reliable liquid level measurement device. Although accurate and reliable instruments were currently available, unique situations at the Rocky Flats Plant made most of these devices impractical. Some of the criteria used in the selection of a liquid level measurement device for use in the chemical processing areas of the plant included: (a) exceptional accuracy and reliability, (b) nonintrusiveness or nonpenetration of the process tank, (c) ease of installation, (d) standard interface electronics, (e) a digital display, and (f) moderate cost. This paper details the selection, operation, and production use of the Bartex Aquatrak Model LG-1101 Liquid Level Indicator 1. This was the only system tested which met or exceeded all of the requirements that were set. 2 references, 3 figures.

8428 **(RFP—3738) Effective use of SDM/70 to develop an interactive, multi-user standards laboratory system at Rocky Flats Plant.** (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 23 Aug 1984. Contract AC04-76DP03533. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004053.

This paper considers how the analysis, design, and implementation of the Interactive Measurement Evaluation and Control System (IMES) has been possible, even when three previous attempts have failed. The success is believed to be primarily due to the use of the methodology SDM/70, which is marketed by AGS Management Systems, Inc.

8429 **(SRDP-R—80) Progress report for the period September 1980-September 1981.** Adams, J.M. (ed.). (UKAEA Atomic Energy Research Establishment, Harwell. Safeguards R and D Project). Mar 1982. 45p. NTIS (US Sales Only), PC A03/MF A01. File Number TI84703474.

This is the first comprehensive report of work carried out in the UK on Safeguards R and D in support of the IAEA. The bulk of the work herein has been completed during the last six months though for the sake of completeness, work of the preceding half year has been included for a few projects. The report falls under the headings: service programmes (including training courses); generic programmes, covering those elements of instruments and systems that are common to many systems; plant studies (general); centrifuge enrichment plant safeguards; field trials; exploratory and short projects.

8430 **(SRDP-R—97) Tamper proofing of safeguards monitors.** Riley, R.J. (UKAEA Atomic Energy Research Establishment, Harwell. Safeguards R and D Project). Nov 1982. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number TI84703475.

The tamper proofing of safeguards monitors is essential if the data they produce is, and can be seen to be, reliable. This report discusses the problem of tamper proofing and gives guidance on when and how to apply tamper proofing techniques. The report is split into two parts. The first concerns the fundamental problem of how much tamper proofing to apply and the second describes methods of tamper proofing and discusses their usefulness. Both sections are applicable to all safeguards monitors although particular reference will be made to doorway monitors in some cases. The phrase 'tamper proofing' is somewhat misleading as it is impossible to completely tamper proof any device. Given enough time and resources, even the most elaborate tamper proofing can be overcome. In safeguards applications we are more interested in making the device tamper resistant and tamper indicating. That is, it should be able to resist a certain amount of tampering, and if tampering proves successful, that fact should be immediately obvious. Techniques of making a device tamper indicating and tamper resistant will be described below. The phrase tamper proofing will be used throughout this report as a generic term, including both tamper resistance and tamper indicating.

8431 **(SRDP-R—107) Modelling of the application of near real time accountancy and process monitoring to plants.** Huddleston, J.; Stockwell, M.K. (UKAEA Atomic Energy Research Establishment, Harwell. Safeguards R and D Project). Sep 1983. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number TI84703472.

Many statistical tests have been proposed for the analysis of accountancy data from nuclear fuel reprocessing plants. The purpose of this programme was to assess the performance of these tests by applying them to data streams which simulate the information that would be available from a real plant. In addition the problems of pre-processing the raw data from a plant were considered. A suite of programs to analyse the data has been written, which include colour graphical output to allow effective interpretation of the results. The commercial software package VisiCalc has been evaluated and found to be effective for the rapid production of material balances from plant data.

8432 **(SRDP-R—111) Monitoring the ^{235}U enrichment of uranium deposited on pipes in centrifuge plants operating at low pressures using a high resolution gamma-ray spectrometer.** Packer, T.W. (UKAEA Atomic Energy Research Establishment, Harwell. Safeguards R and D Project). Jan 1984. 32p. NTIS (US Sales Only), PC A03/MF A01. File Number TI84703473.

Methods are described for determining the ^{235}U enrichment of uranium deposited on pipes in centrifuge plants operating at low pressures using a γ-ray spectrometer. Results of measurements made on eight centrifuge cascades that had been in operation for several years are given. It is shown that the ratio of the number of 84 keV γ-rays emitted by ^{231}Th, a daughter of ^{235}U, to the number of 63 keV γ-rays emitted by ^{234}Th, a daughter of ^{238}U, enables the ^{235}U enrichment of the deposited uranium to be determined without the inspector needing to know the operating pressure of the centrifuge. It is possible to determine the ^{235}U enrichment of the uranium deposited on product pipes to within +-5% relative of the average declared value in a measurement time of 4 hours when using a high resolution γ-X semi-conductor detector. The presence of directly deposited thorium fluoride on the pipes has been established. As the ratio of the number of $^{231}Th/^{234}Th$ atoms deposited is a measure of the enrichment of the UF_6 gas currently being produced, it also enables gross misuse of the centrifuge plant during the period of inspection to be detected.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0702 Radiation Sources

REFER ALSO TO CITATION(S) 0702009006

8433 **(PB—84-242015) American National Standard N43.10; safe design and use of panoramic, wet source storage gamma irradiators (category IV). Final report.** (American National Standards Inst., New York). Jul 1984. 36p. (ANSI-N—43.10-1984). NTIS, PC A03/MF A01.

Also available from Supt. of Docs as SN003-003-02598-4. Library of Congress catalog card No. 84-601091.

This standard applies to panoramic, wet source storage irradiators (Category IV) that contain sealed gamma emitting sources for the irradiation of objects or materials. It establishes the criteria to be used in the proper design, fabrication, installation, use, and maintenance of these irradiators which will ensure a high degree of radiation safety at all times. The requirements of the standard are grouped as (1) general considerations, (2) manufacturer's responsibility, and (3) owner's responsibility. Included in the first group are general radiation protection criteria, sealed source performance requirements, and radiation survey needs. Among the manufacturer's responsibilities are criteria for maximum external radiation levels, integrity of shielding, and controls and indicators. The requirements for users include safety-related servicing, administrative procedures, operator qualifications, and routine safety tests.

8434 **(PB—84-242981) American National Standard N542; sealed radioactive sources, classification. Final report.** (American National Standards Inst., New York). Jul 1978. 30p. (ANSI-N—542-1977). NTIS, PC A03/MF A01.

This standard establishes a system of classification of sealed radioactive sources based on performance specifications related to radiation safety. It provides a manufacturer of sealed sources with a series of tests for evaluating the safety of his product under specified conditions, and also assists a user of such sources to select a type which suits the intended application insofar as maintenance of source integrity is concerned. Tests are prescribed for temperature, external pressure, impact, vibration, and puncture over a range of severity. Sealed source performance requirements are identified for a variety of source applications, in terms of a specific degree of severity of each test. Appendixes are included on the subjects of leak test methods, quality assurance and control, brachytherapy sources, self-luminous light sources, and special form radioactive material.

08 HYDROGEN

0801 Production

REFER ALSO TO CITATION(S) 0801009374, 9374

8435 **(AD-A—145983/3/XAD) Studies of hydrogen production by the water gas shift reaction and related chemistry. Final technical report 1 September 1980-31 March 1983.** Eisenberg, R. (Rochester Univ., NY (USA). Dept. of Chemistry). 15 Apr 1983. 18p. NTIS, PC A02/MF A01.

Many systems have been investigated for the catalysis of the water gas shift reaction and for electrocatalytic oxidation of CO. These systems have involved precious metal complexes composed of Pt, Rh, and Ir, and reaction conditions for these systems have been especially mild: atmospheric pressures and low temperatures. In addition aqueous acidic conditions for these systems have been pursued with particular interest in adopting water gas shift catalysts to act as electrocatalysts for the anode reaction of CO fuel cells.

8436 **(BNL—35458) Alternative anodic reactions in water splitting. Final report.** Murphy, O.J.; Bockris, J. O'M. (Brookhaven National Lab., Upton, NY (USA)). Oct 1984. Contract AC02-76CH00016. 112p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85004159.

An anodic depolarization path to hydrogen production through water electrolysis has been examined, using lignite, grass and household wastes. Iron was removed from lignite by extensive washing. The degree of dissolution of lignite in 5 M H_2So_4 at 100°C is ca. 0.1 wt %. Washed lignite dissolves less than unwashed material. Cyclic voltammograms showed peaks arising from dissolved organics. Increase of temperature produced more peaks. In alkaline solution, peaks disappeared. Oxidation currents were three times greater if the lignite particles were in contact with the electrode compared with their absence from solution. Platinum anodes oxidized lignite better than PbO_2. Redox systems, added to the electrolyte, helped compound formation. Grass and household wastes gave similar results but lower oxidation currents. Compounds present in solution prior to electrolysis dissolve off the internal surfaces of lignite particles. Increased oxidation currents, caused when lignite particles came in contact with the anode, arose, not because of enhanced electrochemical reactions, but from enhanced lignite dissolution following erosion. The organic compounds eventually form CO_2; the presence of heavy oils lasts for 10 hr. Current densities up to 750 mA cm^{-2} at ca. 1 V should be obtainable. The hydrocarbons are formed via a Kolbe mechanism from carboxylic acids. Speculative economic considerations show that the final cost of hydrogen produced, using lignite as an anode depolarizer, is considerably cheaper than that from natural gas: $0.40 per GJ, or less, compared to $5 per GJ.

8437 **(PB—85-108264/XAD) Electrochemistry in the hydrogen economy.** Salmivaara, L.; Virtanen, R. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Kemian Lab.). [1984]. 97p. NTIS, PC E05/MF E01.

The energy crisis in the early 1970's, the inevitable exhaustion of fossil fuels, as well as the polluting effect of the use of present fuels have been facts that have led to ambitious plans for developing a worldwide energy system based on hydrogen. The fields of research in Hydrogen Economy pertain to the production, transmission, storage, and utilization of hydrogen. The purpose of this paper is to survey literature to obtain the current status of the electrochemical methods for producing and utilizing hydrogen. The methods examined were narrowed down to the solely electrochemical methods, in other words photoelectrolysis and electrolysis for the production of hydrogen and fuel cell for the utilization of hydrogen.

8438 **(PB—85-113421/XAD) Production of hydrogen by cyanobacteria. Final report April 1982-March 1984.** Packer, L. (California Univ., Berkeley (USA). Membrane Bioenergetics Group). Jun 1984. 80p. NTIS, PC A05/MF A01.

See also PB83-228379.

This is a final report on phase I of research on 'Production of Hydrogen by Cyanobacteria'. Cyanobacteria (blue-green algae) use sunlight to produce sugars and O_2, as true plants do, yet also use N_2 from the air to synthesize the basic building blocks needed by all life, and in a side reaction produce H_2. The algae employ a strict division of labor to protect H_2 production from destructive effects of O_2. They form heterocysts whose thick walls keep out most of the O_2, but some 'leaks' in. A novel system to measure O_2 production inside the cell was developed. The detection method is based on the interaction of unpaired electrons of O_2 with unpaired electrons from a test nitroxide molecule. H_2 production in the presence of sulfide is stimulated by an order of magnitude. Three iron-containing proteins in heterocysts have been identified by EPR methods to act as catalysts for H_2 production. The goal is to identify enough of the chemical steps leading to increased H_2 gas production so that the process can be artificially improved. Another approach was to 'tune' the system by controlling environmental factors. For this the adaptation process which allows the algae to grow at high salinity was used as a strategy to allow the algae to produce H_2 under pilot plant conditions.

0802 Storage

REFER ALSO TO CITATION(S) 0802008910

8439 **(DOE/ER/05246—T3) Investigations of intermetallic alloy hydriding mechanisms. Final report.** Livesay, B.R.; Larsen, J.W. (Georgia Inst. of Tech., Atlanta (USA). Engineering Experiment Station). 1983. Contract AS05-76ER05246. 123p. NTIS, PC A06/MF A01; GPO Dep. File Number DE85004095.

RT_5 hydrogen storage alloys, particularly $LaNi_5$, were investigated using a variety of techniques, including: torque magnetometer, SEM, magnetization, flexure of cantilevered specimens. Kinetics of hydridation-dehydridation cycles were studied. 39 figures. (DLC)

8440 **(NP—5770065) Experimental and theoretical investigations of the discharge of metal hydride stores for internal combustion engines running on a mixture of hydrogen and petrol.** Luxenburger, B. (Kaiserslautern Univ. (Germany, F.R.). Fachbereich Maschinenwesen). 20 Dec 1983. 166p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number TI85770065.

A calculation model is introduced, which describes the discharge process of hydride stores. The model calculation is used for single pipe stores and stores consisting of bundles of pipes, where the feasibility of the simulation calculation is proved by suitable experiments. During the engine experiments, here carried out with a mixture of hydrogen and petrol, interesting parameters for hydride storage technology are first determined in stationary engine operation. In order to include non-stationary working conditions, the engine marginal parameters are determined based on driving cycles. In order to examine the discharge of metal hydride stores in conjunction with internal combustion engines, the model calculation is connected with the experimentally determined engine marginal parameters.

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 0901108251

8441 **(BMFT-FB-T—84-222) Investigations on catalysts, selectivities and reactor types in Fischer-Tropsch-synthesis. Vol. 1.** Hubert, H.J.; Tillmetz, K. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Schering A.G., Berlin (Germany, F.R.)). Oct 1984. 174p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number TI85780226.

The investigations were aimed to develop novel catalysts for production of olefins with high selectivities and to find reactor types most suitable for this synthesis. The first volume describes at-

tempts to produce high olefin yields. With modified Mn/Fe-catalysts, a Csub(2/4)-olefin selectivity of 48% of carbon fed and a Csub(2/4)-olefin yield of 77 g/m syngas can be obtained. Product composition can be varied in a large range by zeolite addition and, therefore, can be fitted to the demands of market. In the second volume, it is shown that novel matrix catalysts produce with high selectivity linear alpha-olefins with medium range chain length. The product mix is composed of 93% unbranched hydrocarbons with an olefin content of 78%. Double bounds are located in 97% in alpha position. The third volume describes studies on liquid phase reactors suited for selective olefin synthesis, considering the great importance of isothermal reaction conditions. Most suitable is the slurry phase bubble column.

8442 (CONF-8109271—Exc., pp 2.1-2.12) **Batch digestion of manure to investigate the acceleration or inhibition effects of some additives.** Hansen, S. 1981. NTIS (US Sales Only), PC A05/MF A01. File Number TI85770103.

From 2. international symposium on anaerobic digestion; Travemunde, F.R. Germany (7 Sep 1981).

Different batch digestions of manure are carried out to determine how much gas can be produced from a specific manure and what affects this gas production - and the composition of the gas. Continuous experiments are also made for comparison. However, the batch digestion is found to be a satisfactory method to see the "on/off" effect. The method used is a batch digestion in which manure is digested in a 5 l bottle. The produced gas is collected in another bottle in which there is H_2SO_4 to minimize absorption of CO_2. The digestion bottle is kept under mesophilic conditions in a thermostatic room. The gas yield is measured at this temperature. The gas is analysed for CO_2, N_2, O_2, H_2S, and CH_4 on a GOW-MAC thermal conductive gaschromatograph. Two antibiotica Emtoyl and Tylan have a significant decreasing effect on the gas production. A positive effect by adding some enzymes (cellulase, hemicellulase, amylase, and proteinase) to the manure has been observed.

8443 (CONF-8109271—Exc., pp 5.01-5.26) **Three full-scale biogas plants.** Kraemer, S. 1981. NTIS (US Sales Only), PC A05/MF A01. File Number TI85770103.

From 2. international symposium on anaerobic digestion; Travemunde, F.R. Germany (7 Sep 1981).

As part of the Danish development program on biogas from animal waste, 3 full-scale biogas plants were erected in 1979. The three plants are based on different types of process layout, construction methods, choice of materials and energy utilization as well as various types of animal waste. All the plants are designed for a semi-continuous, mesophilic operation with feeding - in at last each day. For each biogas plant a description is given of the structural design, type of manure, the manure handling system, gas utilization, and operational experiences. Results of biogas production and gas utilization (either power production or heat production) are also given for each plant.

8444 (CONF-8109271—Exc., pp 6.1-6.9) **Economic results and calculations for biogas plants in Danish agriculture.** Parsby, M.S. (Institute of Agricultural Economics, Copenhagen, Denmark). 1981. NTIS (US Sales Only), PC A05/MF A01. File Number TI85770103.

From 2. international symposium on anaerobic digestion; Travemunde, F.R. Germany (7 Sep 1981).

The technical and economic results of a representative year of operation for one of the three Danish demonstration plants are estimated and evaluated based on data obtained as a part of the registation- and measurement programme. These data are utilized together with results from laboratory tests etc. as a basis for estimates of the maximum allowable investment for profitable biogas production. The advantage of this method is that the considerable uncertainty in the estimate of the necessary invested capital is eliminated. Further, sensitivity analyses on the results are carried out. This is necessitated partly by the unknown future energy price trend, interest level and inflation partly by uncertainty on the technical economic parameters. Finally economic consquences of partial energy utilization in the private household and of possible environmental improvements are discussed.

8445 (CONF-8109271—Exc.) **Presentation of the STUB-programme at the second international symposium on anaerobic digestion.** (STUB Samarbejdsgruppen for Teknologisk Udvikling af Biogas, Glostrup (Denmark)). 1981. vp. NTIS (US Sales Only), PC A05/MF A01. File Number TI85770103.

From 2. international symposium on anaerobic digestion; Travemunde, F.R. Germany (7 Sep 1981).

Separate abstracts have been prepared for items within the scope of the Energy Data Base.

8446 (CONF-8404199—, pp vp) **Processing of landfill gas for use as fuel.** Knop, R. 1984. (In German). NTIS (US Sales Only), MF A01. File Number TI85770037.

From 4. colloquium on waste management; Saarbruecken, F.R. Germany (26 Apr 1984).

By means of references from literature and experiments of our own, it was possible to show that there are quite purposeful opportunities to increase the energy content of landfill gas by reducing its carbon dioxide content. This improvement of its quality signifies an improvement of its marketability. A marked reduction of a substantial proportion of polluting gases partially contained in the landfill gas is expected as a possible outcome of further tests. If testing succeeds in proving the profitability of liquid natural gas [LNG] production from landfill gas, its application as vehicle fuel will have to be effected with the natural gas technology existing on the market.

8447 (CONF-8404199—, pp vp) **Diffuse emissions from sanitary landfills - measurement method, evaluation, sanitation.** Dernbach, H. 1984. (In German). NTIS (US Sales Only), MF A01. File Number TI85770037.

From 4. colloquium on waste management; Saarbruecken, F.R. Germany (26 Apr 1984).

Relatively large contents of easily volatile chlorinated hydrocarbons were proven to occur in landfill gas. These chlorinated hydrocarbons mainly decompose to hydrogen chloride and carbon dioxide in the combustion chamber of the engine (dual-purpose power plant). The agressive hydrogen chloride attacks the engine materials directly and via an acidification of the motor oil. Corresponding proportions of acid and chlorine as well as contents of copper and iron could be shown in the motor oil. Within a research project which is promoted by the Federal Ministery for Research and Technology and accompanied by the Federal Environment Agency, attempts are made to either prevent corrosion through measures performed on the motor oil and on some engine components or to reduce it to such an extent as to obtain normal operational conditions approximately. Further studies are made on possible methods for eliminating easily volatile chlorinated hydrocarbons from landfill gas by means of adsorption processes (activated carbon, molecular screens, artificial resins), by absorption processes (gas scrubbing) and condensation processes (cooling).

8448 (CONF-8404199—, pp vp) **Emissions from domestic refuse landfills: Establishment and treatment of leachates and landfill gas in practical landfill management.** Oeltzschner, H. 1984. (In German). NTIS (US Sales Only), MF A01. File Number TI85770037.

From 4. colloquium on waste management; Saarbruecken, F.R. Germany (26 Apr 1984).

Gaseous emissions from refuse landfills consist in gases which are mainly composed of methane and carbon dioxide. A special problem is posed by the tendency of the landfill gas not only to spread throughout the landfill body proper but also to migrate to the adjacent areas. For this reason, landfills have to be equipped with degassing shafts for gas discharge.

8449 (PB—85-100808/XAD) **Thermal depolymerisation of waste tires by heavy oils. Conversion into fuels. Final report.** Audibert, F.; Beaufils, J.P. (Commission of the European Communities, Luxembourg). [1984]. 24p. (EUR—8907-EN). NTIS, PC E03/MF E03.

The French Institute of Petroleum has developed a process of valorization of waste tires into fuels. The process consists in treating the whole tires with heavy hydrocarbons which transfer

the heat for reaching the required temperature and dissolve the oligomers resulting from devulcanization and depolymerization reactions. The tire is converted into moderate amount of gas and gasoline and mainly into heavy oil loaded with finely dispersed carbon black. Results have been obtained on a large size pilot plant making the process directly applicable on the industrial scale.

8450 **(PB—85-102002/XAD) State-of-the-art report for small scale (to 50 kw) gas producer - engine systems.** Kaupp, A.; Goss, J.R. (California Univ., Davis (USA). Dept. of Agricultural Engineering). Mar 1981. 285p. NTIS, PC A13/MF A01.

Based on a literature search of over 1,200 publications (most concerning work done prior to 1950), a review of over 600 papers obtained through the search, and 130 responses to questionnaires sent to 400 institutions in 63 countries worldwide, this state-of-the-art report details small gas producer engine systems (GPES's) currently in operation, manufacturers of off-the-shelf equipment, the technical feasibility of installing new systems in developing countries, constraints and difficulties related to gasification, and research conducted at the University of California at Davis on gasification of wood and crop residue. Topics include a history of small GPES's, the chemistry of gasification, fuel for small and medium fixed bed gas producers, conditioning of producer gas, the latter's application in internal combustion and diesel engines, and the economics of GPES's.

8451 **(PB—85-102051/XAD) State-of-the-art report on methane fermentation of biomass.** Woods, S.L.; Vause, K.H.; Skrinde, R.T. (Olympic Associates Co., Seattle, WA (USA)). Sep 1980. 324p. NTIS, PC A14/MF A01.

Research and development on biogas have emphasized technologies for expediting natural methane generation from anaerobic digestion of biomass. This indepth study reviews the status of biogas technology in developing countries and assesses the feasibility and desirability of expanding biogas production. First, based on an extensive review of the literature, the principal technical, social, economic, and environmental issues associated with methane production from farm-and feedlot-scale biogas plants and from marine biomass, urban refuse, and landfill are delineated. The microbiological processes underlying anaerobic digestion and the influences of various environmental factors (e.g., mixing, heating, toxicity, pH, retention time, nutrients) on the digestion process are then described. Raw materials available for biogas, different biogas plant designs (e.g., Chinese, Indian, Philippine, and bag), and the maintenance, operation, and safety of biogas plants are discussed. Next, the composition, fuel value, and processing of biogas are examined; attention is also given to the uses of sludge by-products. The ecological, health, and sociocultural implications of constructing and operating biogas plants in developing countries are reviewed and the status of biogas technology is described. The authors conclude that in both developed and developing countries the energy value obtained through biogas generation is only slightly greater than the costs involved. Thus, a major factor in implementing biogas projects is reclamation of by-products for animal feed and fertilizer. In rural areas where kerosene is expensive and labor inexpensive, a very simple biogas system producing a substantial portion of a family's needs may be feasible, but even in these cases current plant designs may be too costly. Cost effectiveness improves when human waste is incorporated into the system. More than 50 tables and 30 figures are included.

8452 **(PB—85-103869/XAD) Consideration of applications of olefin metathesis in synthetic fuel production.** Hevelng, J. (Council for Scientific and Industrial Research, Pretoria (South Africa). Chemical Engineering Research Group). Jul 1984. 16p. (CSIR-CENG—522). NTIS, PC E03/MF E01.

One of the characteristics of Fischer-Tropsch synthesis and many oligomerization processes, is insufficient selectivity. Efforts have to be made to bring the products obtained in line with the market requirements. The olefin metathesis reaction has the potential to convert less desirable olefins to more useful ones and provides new ways of producing petrochemicals. Based on existing and suggested process technologies, applications of this reaction for the production of synthetic liquid fuels are discussed.

8453 **(PB—85-103877/XAD) Oxidation-reduction model for reaction rate oscillations in Fischer-Tropsch synthesis over iron catalysts.** Caldwell, L. (Council for Scientific and Industrial Research, Pretoria (South Africa). Chemical Engineering Research Group). Sep 1984. 27p. (CSIR-CENG—501). NTIS, PC E04/MF E01.

Non-isothermal rate oscillations in Fischer-Tropsch (F-T) synthesis over iron catalysts can be qualitatively modelled by accounting for changes in the oxidation state of the catalyst. The model suggests that sustained high conversions in single-pass reactors will be difficult to attain.

8454 **(STUB—13) Biogas production based on manure digestion. Ammonia effect on anaerobic, mesophilic digestion of swine, cattle and fowl manures.** Petersen, G. (Bioteknisk Inst., Kolding (Denmark)). Oct 1983. 95p. (In Danish). Bioteknisk Inst., Kolding, Denmark. File Number TI85750403.

This report contains experimental data from laboratory scale anaerobic mesophilic methane fermentation from farm manure with ammonia-nitrogen levels in the range of 1.5 to 14.0 g NH_3-N per litre of fermenting liquid. Experiments were carried out both in continuously and batch fed systems to study the effects of both short-term and long-term exposure to the various ammonia-nitrogen levels. The general effect of extra added ammonia-nitrogen was a decrease in the biogas production. In the following batch experiment the effect of substrate type on ammonia inhibition level was investigated. The results indicated that the ammonia sensitive reactions in the anaerobic breakdown of organic material are either the hydrolysis or the intermediate reactions rather than the methanogenesis itself. The relative decrease in biogas production from acetic acid was 4.2% per g N/l added while the corresponding value for celluloses was 20% decrease per g N/1 added.

0902 Alcohol Fuels

8455 **(DOE/OR/21400—T76) Utilization of synthetic fuels other than hydrogen.** Gregory, D.P.; Dufour, R.J. (Institute of Gas Technology, Chicago, IL (USA)). May 1972. Contract AC05-84OR21400. 53p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85003707.

This report reviews the utilization aspects of several synthetic fuels in the areas of transportation; commercial, residential, and industrial use; and electricity generation. Fuels such as ammonia (NH_3), hydrazine (N_2H_4), methanol (CH_3OH), and ethanol (C_2H_5OH) can be readily synthesized and are therefore discussed here. Another category of fuels, which would be recycled in the oxidized form to the generating station, is the metals. The only reasonable way to consider a metal fuel seems to be as an electrochemical fuel; in this study, rechargeable batteries are, therefore, given brief consideration. 24 references, 5 figures, 5 tables.

8456 **(DOE/R8/01064—T1) Conversion of bakery wastes to ethanol.** Martin, J.E. (Elliotte (Martin J.), Boulder, CO (USA)). 4 Oct 1984. Contract FG48-81R801064. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003582.

The project had the following goals: (1) determine the actual yields of ethanol from the waste products of major bakeries in the Denver area by distillation in a laboratory bench scale distillation column; (2) determine the expected yields of ethanol from the major types of wastes produced by the large bakeries in the Denver area; (3) increase alcohol yields to the maximum possible by identifying any inhibitors and taking steps to remove them; (4) purify the distilled alcohol if necessary to remove any by-products distilled off with the alcohol. The production of alcohol from bakery wastes is feasible. The average yield of the bread type products is 19.8% by weight with yields ranging up to 25%. In other words, on the average, for every 1000 pounds of waste, 198 pounds or 30 gallons of alcohol would be produced. This estimate is conservative since a larger facility would tend to get a better yield (due to the difficulties of getting all the alcohol out of the small batches run). The major variable appeared to be the yeast. Fresh yeast should always be used. No yeast nutrients were tried in these experiments, since the yeast seemed to grow well. However, this could be an area of further investigation. It is possible that the yields could be kept

consistently high by providing the yeast with nutrients. Finally, contamination of the alcohol with oils can be a problem, although not necessarily a very significant one. Methods do exist to remove the oil during the actual distillation, as well as, before distillation. Careful distillation also tends to lessen the problem. 7 references, 4 figures, 2 tables.

8457 **(PB—84-243914) Methanol vaporization: effects on volumetric efficiency and on determination of optimum fuel delivery system. Technical report.** Clemmens, W.B. (Environmental Protection Agency, Ann Arbor, MI (USA). Technical Support Staff). Aug 1984. 82p. NTIS, PC A05/MF A01.

The hypothesis of this study was 'Can methanol injected into the upstream air passages (additionally to the normal port injection) cool the inlet air sufficiently through vaporization to increase the volumetric efficiency, and will the expected increase in volumetric efficiency translate into improved thermal efficiency.' This hypothesis is derived from the mathematical equation of volumetric efficiency in which the efficiency is proportional to the mass of air per unit of time flowing through the engine relative to the swept volume of the engine during that time. Vaporization (through fumigation) in the inlet air should cause a temperature drop of the air, which would increase density and mass flow. To test this hypothesis, two methods of fumigation were tested, both occurring along with the normal port injection of the Nissan 2.0 litre NAPS-Z engine. Neither method improved volumetric or thermal efficiency. In fact, the normal port injection without fumigation gave slightly better results. Because none of the fumigation systems tested demonstrated any increase in efficiency at the lower power levels tested, EPA recommended that any plans for fumigation testing on this engine in the future be discontinued.

8458 **(PB—85-102077/XAD) State-of-the-art report on status of wood hydrolysis for ethanol production.** Baker, A.J.; Jeffries, T.W. (Forest Service, Madison, WI (USA). Forest Products Lab.). Jun 1981. 71p. NTIS, PC A04/MF A01.

Ethanol is a potentially important substitute liquid fuel for energy-deficient developing countries. This state-of-the-art report describes the most prominent methods for producing ethanol from wood. There are two general methods for producing ethanol from wood: (1) acid hydrolysis of wood into hexose sugars which are then fermented into ethanol, and (2) enzymatic hydrolysis, which involves pretreating wood to yield a product from which cellulose is hydrolyzed into sugar which is then fermented into ethanol. The authors proceed to discuss in succession: the availability, reliability, and chemical composition of raw materials; the specific acid hydrolysis processes used by Georgia Institute of Technology, New York University, American Can Company, Forest Products Laboratory, and a Brazilian firm; mechanical, thermal, solvent, acid and other methods for pretreating wood; and the enzymatic hydrolysis processes used by Natick, Gulf Oil Company, Massachusetts Institute of Technology, and Penn/General Electric. Presented next are descriptions of current technologies for fermenting hexose (conventional practice, vacuum fermentation, immobilized cells, and zymomonas fermentation) and pentose (xylulose fermentation, direct conversion of xylose to ethanol, and bacterial fermentation). The authors conclude that since few techniques have reached the pilot plant and production stages in developed countries, equipment and production costs cannot be established. However, the developing countries most likely to consider producing ethanol are those with high forest growth capacity; an energy deficit; a need for economical, internally-produced liquid fuels; and a low capacity for producing agricultural materials for ethanol production. Appended is a 106-item bibliography (1819-1981).

8459 **(STEV-BF—83-11) Production of ethanol based on lignocellulose.** Hamp, S; Arnap, L. (Statens Energiverk, Stockholm (Sweden)). Jun 1983. 65p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number TI85750454.

This report is a feasibility study of a process for the production of ethanol via enzymatic hydrolysis of straw followed by fermentation. It includes a cost calculation and a sensitivity analysis of the important parameters influencing the costs. One of the aims of the study has been to clarify which parts of the process need to be developed further. Basic data for the calculation have been obtained by laboratory experiments as part of this project. Costs are based on mid-83 prices. The calculation shows that the production cost for 30.000 tonnes per annum of 95 percent ethanol would amount to 24 SEK/l of which enzyme related costs are 88 percent. Under the same assumptions the production cost for ethanol via acid hydrolysis would be about 2,50 SEK/l. The most important conclusions of this evaluation are, that enzymatic hydrolysis of straw is at present not to be considered as an alternative technique for ethanol production based on lignocellulosic materials. Research and development efforts should, primarily, be concentrated on finding ways of bringing down costs for enzymes, for example, by recirculation and/or improved pretreatment. It is also important to increase the overall yield of ethanol.

0903 Inorganic Hydrogen Compound Fuels

REFER ALSO TO CITATION(S) 0903108455, 8900

0904 Solid Waste And Wood Fuels

REFER ALSO TO CITATION(S) 0904008484, 8486, 8772, 9046

8460 **(PB—84-243096) Sewage sludge incinerator fuel reduction, Hartford, Connecticut.** Verdouw, A.J.; Waltz, E.W.; Gilbert, P.F. (Battelle Columbus Labs., OH (USA)). Aug 1984. 56p. NTIS, PC A04/MF A01.

Prepared in cooperation with Indianapolis Center for Advanced Research, IN, and Hartford Metropolitan District Commission, CT.

A field demonstration project was conducted at Hartford, Connecticut, which showed that the supplemental fuel usage for sewage sludge incineration could be reduced 83%. This was accomplished by using a belt press filter for dewatering which reduced fuel usage 65% and then fuel efficient burning procedures and operator training further reduced that amount 51%. The Hartford plant originally used 122 gallons of fuel per ton of dry sludge burned, now it uses about 22 gallons of fuel per dry ton burned. Essentially all the 22 gallons of fuel are used to keep the incinerators warm on the weekend when sludge is not burned.

8461 **(SI—8-1983) Biological and chemical processes in stored fuel chips. Loss of dry matter. Drying. Health risks.** Kofod, E.O. (Skovteknisk Inst., Copenhagen (Denmark)). 1983. 20p. (In Danish). Skovteknisk Inst., Copenhagen, Denmark. File Number TI85750411.

A presentation of the main results from recent years' research, based on literature studies. The report describes the heat development in piles of chips, the fire risk (self-ignition) of chip storing, and the airflow arising from the heat development in the pile. The micro-biological and chemical processes are outlined, and the impact of storing on dry matter percentage and moisture content (hence on heat value) is described. Finally the health risks are discussed.

13 HYDRO ENERGY

8462 (CONF-8211194—, pp 11-20) **Significance of small-scale hydroelectric power plants with regard to energy policy.** Frank, W. 1982. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number TI85770058.

From Seminar on small-scale hydroelectric power plants; Vienna, Austria (1 Nov 1982).

This paper reports on the situation of hydroelectric power plants (maximum 10 MW) in Austria. A survey of the future potential of small-scale power plants comprises not only the thermal but also the hydraulic small-scale power plants. Finally, some measures are discussed which shall help to continue the advancement of hydroelectric power plants.

8463 (CONF-8211194—) **Small-scale hydroelectric power plants.** (Oesterreichische Investitionskredit A.G., Vienna). 1982. 136p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number TI85770058.

From Seminar on small-scale hydroelectric power plants; Vienna, Austria (1 Nov 1982).

Separate abstracts were prepared for individual papers. (MHR)

8464 (DOE/ID/12254—1) **Small Hydropower Technology Transfer Project. Task A: feasibility studies.** Cunningham, C.B.; Christensen, J.P.; Engebretsen, A.R. (International Engineering Co., Inc., San Francisco, CA (USA)). Jun 1984. Contract AC07-82ID12254. 637p. NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE85004133.

This report summarizes an investigation of 240 feasibility studies of small hydropower projects conducted under the National Small Hydropower Program beginning in 1977. It provides a detailed analysis of these studies, both to better understand the significance of the information contained therein, and to present this information in a clear, consistent, and comprehensive manner, for the benefit of future developers of small hydropower projects. With the assistance of a commercially available computer program, the analysis extracted significant data contained in the feasibility studies, and sorted this information into separate categories. These data were then analyzed, and summarized both for each individual project and for the overall program. Findings in the report identify significant relationships among several of the major information categories pertaining to the feasibility of certain types of projects. Categories considered included geographic region, gross head, capacity, and capital costs. In addition, the analysis identifies the essential ingredients of a satisfactory feasibility study and highlights the need for uniformity and thoroughness in the conduct of feasibility studies for small hydropower projects.

1301 Resources And Availability

8465 (NP—5750394) **Measurements of glacier velocity variations at Qamanarssup sermia and at Kitdlerssuaq glacier, West Greenland.** Andreasen, J.O. (Groenlands Geologiske Undersoegelse, Copenhagen (Denmark)). Dec 1983. 31p. NTIS (US Sales Only), PC A03/MF A01. File Number TI85750394.

Ice velocity determinations with short time interval have been carried out at an outlet glacier from a local ice cap. The horizontal and the vertical velocity components show distinct diurnal variations. Close examination indicates that these variations are caused by the change in atmospheric refraction during the day, with the vertical component as the most important. Ice velocity determinations with longer intervals clearly reveal a marked decrease of velocity through the summer season indicating slide of both glaciers during the summer season.

1302 Site Geology And Meteorology

8466 (NP—5750395) **Glaciological investigations in Disco Bay region 1983.** Hoejmark Thomsen, H. (Groenlands Geologiske Undersoegelse, Copenhagen (Denmark)). Jan 1984. 36p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. File Number TI85750395.

Glaciological investigations and reconnaissance in connection with hydropower have been carried out in the Disko Bugt area in 1983. The field programme is mainly concentrated on mass balance measurements on the Inland Ice at Pakitsup ilordlia north-east of Jakobshavn. The measurements show that mass balance conditions in the Jakobshavn area must have been abnormally positive for the 1982/83 hydrological year. Reconnaissance has been carried out in the areas around Kugssup tasia/Tiningnilik, south-east of Christianshaab and in three basins in the Godhavn area on Disko. The selected basins at Pakitsup ilordlia, Jakobshavn and Kugssup tasia/Tiningnilik, Christianshaab are both connected with the Inland Ice. Drainage areas on the Inland Ice, draining to these basins have been delineated on the basis of existing maps and information from Landsat data. Water level variations of the ice-dammed lake Tiningnilik have been compiled on the basis of aerial photographs, Landsat images, Geodetic Institute maps and scattered field observations and water volumes calculated.

8467 (NP—5750401) **Glaciological explorations Frederikshaab/Pamiut 1982.** Weidick, A.; Hoejmark Thomsen, H. (Groenlands Geologiske Undersoegelse, Copenhagen (Denmark)). Jun 1983. 56p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. File Number TI85750401.

The glacial conditions influence to a high degree the possibilities of hydropower in Frederikshaab district. At present most interest is focused on a basin area around Iterdla (basin no. 1BIO3) where the margin of the Inland Ice will be partly included in future hydropower utilization. Mass balance investigations of the margin of the ice sheet are not made in the area, but the conditions (height of snow line, surface facies) suggests melt conditions close to those measured at Nordbogletscher in South Greenland and at Qamanarssup sermia at the head of Godthaabsfjord. On the ice sheet surface, the delineations of the individual sectors can only be made with great uncertainty, laterally as well as upstream to the accumulation area. A preliminary re-evaluation of the extent of the sectors is made on the basis of satellite information. Evaluation of the discharge of meltwater to the individual valleys in the ice-free coastland is conditioned by the extent of the individual sectors as well as by the alterations in the ice thickness. A perousal of present information indicates that the Inland Ice margin in the northern parts of Frederikshaab district overall is under recession, generally initiated around 1890. The rate of recession of the ice margin was greatest between about 1920 and 1940 and has continued until the present, although with decreasing rate.

1303 Plant Design And Operation

REFER ALSO TO CITATION(S) 1303008556

8468 (CONF-8211194—, pp 45-75) **Trends in the development of hydraulic turbines and considerations on retrofitting small-scale hydroelectric power plants.** Matthias, H.B.; Koenig, W. 1982. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number TI85770058.

From Seminar on small-scale hydroelectric power plants; Vienna, Austria (1 Nov 1982).

First, a review of the history of hydraulic turbines is given, the design development, and current improvements; then the step-by-step development of small-scale hydroelectric power plants is shown (development stage, expansion stage, and integration stage). The small-scale hydroelectric power plants are classified according to the usable height of fall, the flow of the supply water the storage capacity, and the method of transmission to the supply area. Essential plant components are explained, the operational experience gained up to now with existing plants is discussed, and finally the backfitting and integration of existing plants is discussed.

8469 (CONF-8211194—, pp 77-105) **Current state of the art in the development of electric equipment in small-scale hydroelectric power plants.** Stimmer, H. 1982. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number TI85770058.

From Seminar on small-scale hydroelectric power plants; Vienna, Austria (1 Nov 1982).

Generators transform the mechanical energy supplied by turbines into electric energy. Two types of generator design are applicable, the asynchronous generator and the synchronous generator. The asynchronous generator is simpler in design and is more rugged but can generally only be used in parallel network operation, whereby it must be supplied with reactive power. The sychronous generator is more complicated in design, but it can be used for island as well as for network-parallel operation and offers more flexibility in operation. In general, the generators up to an output of some 600 kW are designed for low-voltage operation, they can be connected with the public utility grid directly or by means of a transformer. Generators of higher output are designed for high-voltage operation and are directly connected with the public utility grid, the energy for in-plant consumption and the low-voltage consumers must be supplied by a special step-down transformer.

8470 **(DOE/ET/20163—T1) Demonstration of the mechanical feasibility of the WLVEC engine. Final report.** Steelman, G. (WLVEC Technology Co., Adel, IA (USA)). May 1980. Contract AC05-77ET20163. 79p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85000631.

From June, 1977 to May, 1980, a building and testing research project has taken place to determine whether the parachute powered water low velocity energy converter WLVEC engine would be a mechanically feasible device to extract usable mechanical energy from the kinetic energy resource found in unconstrained, low velocity, massive flowing streams, i.e., ocean currents, tidal currents, and flowing rivers. A device has been built. The parachute powered loop component has been tested in a flowing river. The corresponding power extraction wheels component has been shop tested. Due to budgetary limitations, a comprehensive in-water field test was not performed. However, it was established that usable shaft RPM/torque is developed via the WLVEC process. A previous demonstration test was conducted in 1976 under the auspices of the Florida Solar Energy Center. That test actually produced electricity from 1/2 knot to 3 knots in the Atlantic Ocean. Taking all available data and results into consideration, it has been established that it is mechanically and technically feasible to develop usable mechanical power and electrical power with the WLVEC engine. It is recommended that further testing of the 1980 model WLVEC engine be done as detailed in the Appendix: Requested Proposal RJ-0-9213-1 Phase II Device Testing and Data Acquisition. Phase II testing will acquire those operational force/power data that were unobtainable with Phase I funding. It is also recommended that a systems engineering study be conducted that is directed towards designing a 10 MW WLVEC plant.

1304 Regulations And Licensing

8471 (CONF-8211194—, pp 21-27) **Construction of small-scale hydroelectric power plants and the licensing procedure and other legal aspects concerning the law on water.** Oberhammer, H. 1982. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number TI85770058.

From Seminar on small-scale hydroelectric power plants; Vienna, Austria (1 Nov 1982).

The Austrian licensing procedure under the law on water is described in detail. The project applications are examined, and in case of approval the license is granted. After completion of the plant, an inspection is carried out. Water rights are principally bound to real estate, they are to be granted for a maximum period of 90 years.

8472 (CONF-8211194—, pp 29-36) **Small-scale hydroelectric power plants - licensing procedures under the law relating to the electricity supply industry.** Nowotny, E. 1982. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number TI85770058.

From Seminar on small-scale hydroelectric power plants; Vienna, Austria (1 Nov 1982).

The spectrum of licensing procedures under the law governing the electric power industry involves a broad field of procedural difficulties. There are the legal sectors: Electrical engineering law, law governing the electric power industry, right of way of utilities (installation of transmission lines), regional planning regulations, protection of nature, building law. The legal position of the builder of small-scale hydroelectric power plants which can be regarded as weak in certain respects must be characterized as especially unsatisfactory. In the author's opinion, however, improvements by legislative measures, can hardly be achieved or desired. Instead informal assistance in advance should be given by close co-operation of the operators of small-scale hydroelectric power plants in order to optimize exchange of information and experience.

1305 Economics And Management

8473 (CONF-8211194—, pp 107-116) **Financing scheme for small-scale hydroelectric power plants.** Rauchwarter, J. 1982. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number TI85770058.

From Seminar on small-scale hydroelectric power plants; Vienna, Austria (1 Nov 1982).

After some principal remarks on the possibilities of financing on credit, the representative of an Austrian credit institution examines in his paper assistance activities applicable to future projects, and he mentions both possible lendors and the credit line. Finally, tax privileges are discussed both with regard to the construction period and subsequent operation of small-scale hydroelectric power plants.

8474 (CONF-8211194—, pp 117-135) **Guide for financing small-scale hydroelectric power plants.** 1982. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number TI85770058.

From Seminar on small-scale hydroelectric power plants; Vienna, Austria (1 Nov 1982).

This guide surveys the course of realization of projected small-scale power plants (max. 10 MW), as well as the financing scheme (on the level of the Federal Government and the Laender Governments), tax privileges, and questions of procedure.

8475 (CONF-8211194—, pp 37-44) **Problems involved in the fixing of prices to be paid by large utilities for electricity supplied by small-scale hydroelectric power plants.** Burian, F. 1982. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number TI85770058.

From Seminar on small-scale hydroelectric power plants; Vienna, Austria (1 Nov 1982).

This paper discusses the background of the profit situation of Austrian small-scale hydroelectric power plants supplying electric power to the public grid. Furthermore, a review is given of the development of the supply prices during the last years, and a preliminary forecast on the future development.

14 SOLAR ENERGY

1401 Resources And Availability

8476 **(PNL-SA—12207) Microprocessor-controlled rotating shadowband radiometer.** Michalsky, J.J.; Berndt, J.L.; Schuster, G.J. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1984. Contract AC06-76RL01830. 4p. (CONF-8408135—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003633.

From International radiation symposium; Perugia, Italy (21 Aug 1984).

At the Pacific Northwest Laboratory (PNL), we have developed a microprocessor-based data logger/controller that we have wed to another PNL-developed device: a movable shadowband radiometer. This combination, which promises to be an effective low-cost instrument for the reliable determination of three fundamental solar parameters, will be described in this paper.

1403 Economics

REFER ALSO TO CITATION(S) 1403008501

1404 Environmental, Legal, And Institutional Aspects

REFER ALSO TO CITATION(S) 1404008501, 9085

8477 **(UCLA—12/1463) Ecological observations at the site of the 10 MWe solar thermal power system (1978-1984).** Lindberg, R.G.; Turner, F.B. (eds.). (California Univ., Los Angeles (USA). Lab. of Biomedical and Environmental Sciences). Sep 1984. Contract AC04-76DR00789. 106p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85004572.

The Laboratory of Biomedical and Environmental Sciences (LBES), acting for USDOE, was assigned responsibility in 1978 for assessing the ecological consequences of constructing, testing, and operating Solar One. In addition, the Southern California Edison Company (SCE) sponsored parallel studies which included wildlife interactions with the facility by the Los Angeles County Museum Foundation (May 1982-May 1983); and air quality monitoring by

the Statewide Air Pollution Research Center, UCR (1979-present). This report is a summary of observations made by LBES between July 1978 and July 1984 citing where appropriate findings of the complementary studies. 69 references, 21 figures, 15 tables.

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 1405008438, 8442, 8443, 8444, 8445, 8446, 8448, 8450, 8451, 8454, 8456, 8458, 8459, 8714, 8783, 9092

8478 **(NP—5750414) Discussion of the possibilities of energy production based on macrovegetation in coastal waters. Report to the Ministry of Energy.** Heerfordt, L.; Krogsgaard Jensen, J. (Vandkvalitetsinstituttet, Hoersholm (Denmark)). Apr 1984. 78p. (In Danish). NTIS (US Sales Only), PC A05/MF A01. File Number TI85750414.

Based on previous investigations of the macrovegetation in the Danish coastal waters, an estimation has been made of the potential annual harvest of biomass. The possibility utilizing the biomass for the production of biogas has been evaluated. A utilization of the naturally occurring biomass is not considered to be profitable at present. Furthermore, environmental problems related to the harvest have not yet been clarified. However, it is evaluated that there exists a potential possibility of utilizing algae produced in areas with controlled and optimal growth in combination with wastewater treatment.

8479 **(NP—5770062) Model calculations and measuring methods for the characterization and registration of the important semiconductor parameters of monocrystalline silicon solar cells.** Scheer, H. (Technische Univ. Berlin (Germany, F.R.). Fachbereich 19 - Elektrotechnik). 26 Oct 1982. 151p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number TI85770062.

In this work the behaviour of monocrystalline n-p-solar cells is studied. A theoretical model is developed which is able to describe the electrical properties of solar cells. The influence of the semiconductor parameters is taken into the consideration. With the help of many new aspects which are published in the literature the mathematical model is derived.

8480 **(NP—5770068) Fertilizer and energy from grape-husks.** Graefe, G. (Bundesministerium fuer Wissenschaft und Forschung, Vienna (Austria); Oesterreichische Akademie der Wissenschaften, Vienna. Abt. fuer Oekosystemforschung). Aug 1983. 163p. (In German and Spanish). NTIS (US Sales Only), PC A08/MF A01. File Number TI85770068.

The research project of the bioenergy converter for grape husk humification belongs to the sector of utilization of biogenous wastes. It shows very clearly that it is possible to obtain high quality end products from so far neglected and annoying wastes just by applying innovative ideas. About 10 million tons of grape husk are annually produced in all countries of the earth together. So far almost nobody noticed that this is a very precious share of the annually produced biomass that was so far dumped on deposits. A method was developed which allows to process husks and convert them under aerobic conditions to high quality humus and in addition to generate energy.

8481 **(PB—85-100691/XAD) Marine Biomass Program, final report April 1981-April 1984.** Tompkins, A.N.; Bryce, A.J. (General Electric Co., Philadelphia, PA (USA). Advanced Energy Programs Dept.). Apr 1984. 171p. NTIS, PC A08/MF A01.

See also PB83-i67247.

This constitutes the Final Report of work performed on the Marine Biomass Program by the General Electric Company and its associates for the Gas Research Institute. An overview of work performed from 1976 through 1982 is provided as background for a detailed discussion of the research and development tasks performed during 1983. The background section discusses previous major program activities such as the Offshore Test Platform, Nearshore Test Farm project at Goleta, and the Hemidome experiment. Also discussed in this section are the anaerobic process development and anaerobic microbiological research tasks. A list of all significant program publications is given. Also provided in this Final Report are detailed progress reports on the 1983 projects which include the development of a comprehensive Kelp Farm Model. This work was performed by the California Institute of Technology and Scripps Institution of Oceanography under the direction of the General Electric Company. This section discusses research tasks in kelp physiology that were performed in order to provide detailed inputs for the model as well as discussing the rationale for construction of the comprehensive model.

8482 **(PB—85-113462/XAD) Marine biomass: New York state species and site studies. Annual report December 1982-November 1983.** McKay, L.B. (New York Sea Grant Inst., Albany (USA)). Aug 1984. 228p. NTIS, PC A11/MF A01.

See also PB84-111392. Sponsored in part by New York State Energy Research and Development Authority, New York, and New York Gas Group, NY.

The New York State Marine Biomass Program began in late 1979 in an effort to develop a feasible system for the production of marine biomass from indigenous macroalgae for economically competitive conversion to synthetic natural gas. During 1983 this goal was brought closer to realization when a 120 x 41 foot seaweed test farm was placed in 60 feet of water in Long Island Sound. The structure is basically a flexible wire cable and rope grid, buoyed at the surface and moored to the bottom of the Sound. It is suitable for cultivating seaweeds which attach themselves to surfaces such as the brown kelp, Laminaria saccharina. This test farm design was chosen from among four which were developed previously by the engineering team.

8483 **(SERI/PR—231-2545) Solar Energy Research Institute Biomass Program. Quarterly technical report, fourth quarter, FY 1984.** Corder, R.E.; Lowenstein, M.Z.; McIntosh, R. (Solar Energy Research Inst., Golden, CO (USA)). Oct 1984. Contract AC02-83CH10093. 84p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85000533.

Highlights of progress made during the fourth quarter of 1984 are summarized. Research was performed in 3 subprograms: aquatic species; anaerobic digestion; and photo/biological hydrogen. In the aquatic species subprogram, investigators: completed evaluation of energy fixation relationship between growth and lipid accumulation (Chlorella SO1); completed evaluation of metabolic blockers to enhance lipid accumulation; determined long-term sustainable productivities for Platymonas in a shallow raceway system; completed evaluation of species screening procedure using Platymonas; issued LOI for collection of microalgae strains; and completed establishment of oleaginous microalgae collection. In the anaerobic digestion subprogram, investigators: completed research on causticized straw-manure mixutre (USDA); performed chemical analysis of different swine manure fractions (Missouri); and completed preliminary evaluation of the conversion of lignocellulosics to liquid fuels with hydrogen iodide and other reductants (SERI). In the photo/biological hydrogen subprogram, investigators: isolated and characterized 10 new strains of photosynthetic bacteria; completed characterization of chemical treatments of O_2 evolution from photosystem II preparations; and submitted two papers on algal hydrogenase. Separate abstracts have been prepared for each program for inclusion in the Energy Data Base. (DMC)

8484 **(SI—2-1981) Production and application of whole-tree chips from softwood thinnings.** Weis Stranddorf, T. (Skovteknisk Inst., Copenhagen (Denmark)). 1981. 37p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. File Number TI85750425.

The object of the investigation was to assess the resource requirements and productivity levels of chip production in three common stand types well suited for chipped wood cropping: Three thinning stands of Norway spruce, one thinning stand of Norway spruce/mountain pine, and one clear cutting of a Norway spruce/mounting pine stand. The object was further to assess the size of the chip yield and the properties of the chips, the latter with respect to its value as a fuel or as a raw material for particle board production. The green chips proved excellently suited as a supplementary fuel, provided that the moisture content was not too high. The trial burning gave boiler efficiencies between 68% and 76%. If

we assess the cost of chips delivered to heating plant at D.kr. 75 per m^3 loose volume, the forest will fetch a modest contribution profit of between D.kr. 16 and 30 per m^3 loose volume chips, dependent on the type of stand producing the chips. When the chips are used as a supplementary fuel in an existing boiler as in the present investigation, the contribution profit per m^3 loose volume chips will amount to approx. D.kr. 41. This amount should cover the operation costs, the stoking, and the profit returned on the extra use of the plant.

8485 **(SI—3-1983) Stump wood harvesting. Methods and machinery for harvesting, processing, and transportation of stump wood.** Baadsgaard-Jensen, J. (Skovteknisk Inst., Copenhagen (Denmark)). 1983. 46p. (In Danish). Skovteknisk Inst., Copenhagen, Denmark. File Number TI85750424.

A description is given of harvesting methods and equipment for stump wood together with transportation of stump wood. Also an analysis is made of the costs of these processes together with a comparative analysis of the costs for stump wood and other competiting fuels such as coal, green chips, firewood, and straw.

8486 **(STEV-SB—83-25) Workload and costs for storing and firing wood chips and straw at family farms.** Salevid, P. (Statens Energiverk, Stockholm (Sweden)). 1981. 62p. (In Swedish). (SLU-LBT—83). NTIS (US Sales Only), PC A04/MF A01. File Number TI85750455.

A study of the labor spent on the fuel cycle and maintenance at farms using wood chips or straw for heating, in most cases one-family farms is presented. The study is based on a survey addressed to some 100 farms. Farms firing wood chips consumed about 70 m^3/year and spent in all, between 84 and 126 working hours/year on the fuel and the installations. The energy cost varied between 0,15 and 0,38 SEK/kWh for the different farms. Straw firing farms consumed about 26 tons/year, with 70-200 workinghours/year. Total energy cost varied between 0,19 and 0,26 SEK/kWh.

8487 **(STEV-SB—83-28) Determination of basic density of chips.** Bjoerklund, L. (Statens Energiverk, Stockholm (Sweden)). 1983. 26p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number TI85750456.

The purpose of this investigation was to study the reliability of the water-immersion-method when measuring the basic density of chips. Both fuelwood chips and sawmill chips were studied. When weighing the sample in water a number of sources of error occur. The biggest are those caused by remaining air bubbles and loss of fines. These errors can for fuelwood chips reach 20 percent. Errors also occur because of water absorption, moisture on the surface of the chips and water temperature but these are less important. Errors caused by loss of fines can be compensated if the true moisture content is known. This can be determined through separate moisture samples. A serie of tests indicated that the basic density should be dependent of the moisture content also above the fibre saturation point. If this was a result of errors or not could not be clarified. Screening of fuelwood chips before density measurement causes a systematic error due to difference between the fractions (wood, bark, needles etc.).

8488 **(STEV-SB—83-31) Harvesting of stumps and rootwood.** Petersson, K.G. (Statens Energiverk, Stockholm (Sweden)). May 1983. 19p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. File Number TI85750457.

The costs of the harvesting (removal of stumps and simple fragmentation and cleaning) and the skiddertransportation were Skr 30 per m^3. The cost of the crushing was Skr 33 per m^3. For estimating the efficiency of the stumpharvester it is necessary to regard the fact that the unit was a prototype. The reduction of the cleaning and the fragmentation to a minimum have increased the production . The production of the skiddertransportation was normal. The crushing of the stumps was difficult, depending on the low level of the fragmentation. A higher level of fragmentation would probably increase the production 50 percent. The main factor affecting costs are: 1. The volume of the stumps 2. The number of stumps per ha 3. The distance of the skiddertransportation 4. The degree of cleaning (removal of stones, soil etc) 5. The degree of fragmentation. The degree of cleaning affects the possibility of using the stumps for combustion purpose. Only a garbage combustion unit can use uncleaned stumps. The degree of fragmentation is the factor, except the volume of the stumps, which has the greatest importance of the cost, but is also the factor which could be managed of all.

8489 **(STEV-SB—83-35) Prototype equipment for water content determination of wood fuels.** Hult, B. (Statens Energiverk, Stockholm (Sweden)). Oct 1983. 14p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. File Number TI85750461.

To determine water content in bunches with whole trees, branches or chips, two different methods both based at the same equipment have been developed. A. MKB 1000 for drilling samples out of bunches from on or another side to a depth of 1000 mm. B. MKB 1500 V for drilling samples from the top of the bunches to a depth of 1500 mm. All tests of representativity of the samples have been made with the A alternative. Extensive tests have been made and we are still testing to get representativity of samples in all seasons of the year. A measuring method wich consists of 4 samples from each truck chosed at random in one side of the three bunches will give both supplier and purchaser an acceptabel determination of water content.

8490 **(STUB—8) Heat exchanging between digested and fresh manure. Technical/economic evaluation of passive heat exchanging systems.** (Carl Bro Gruppen, Glostrup (Denmark)). Mar 1983. 69p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. File Number TI85750410.

The aim of this report is by the means of a technical/economic analysis of heat exchanging systems to elucidate the possibilities of increasing the net energy from biogas plants by heat exchanging between digested and fresh manure. Based on literature studies existing heat exchangers are described together with research carried out for determining heat transfer coefficients of manure. Examples are made of thermal calculation of heat exchangers for biogas plants with mesophilic or thermophilic process temperature, and an energy economic and cost analysis is made. To understand the heat exchanging function the fundamental heat transmission theory is mentioned, together with the theory for thermal calculation of heat exchangers.

8491 **Micro-level land use impacts of bioconversion.** Parsons, V. (Los Alamos Scientific Lab., NM). *International Journal of Energy Systems;* **1**: No. 1, 94-98(1981).

The energy crisis has prompted research and development of renewable energy sources, among which are the bioconversion technologies. Crops, crop residues, manure and other organic wastes are potential sources of liquid, solid and gaseous fuels. These feedstocks originate on the farm or in the forest and therefore are land intensive. Implementation of the bioconversion technologies will involve actions that will impact existing land use patterns. Because of differences in crop type, yield per acre, existing land use conditions, and agricultural practices, an aggregated national approach to the assessment work done at the Los Alamos Scientific Laboratory (LASL) in support of the Department of Energy's Technical Assessment of Solar Energy Program, (TASE) is needed. Local biomass potential, existing land use and potential land use impacts from bio-energy implementation for three of the fifteen counties selected for the TASE study are presented. The methodology developed for the evaluation is useful in determining identifying regional differences inherent in the trade - offs between existing land use and energy production. 18 references.

1406 Photovoltaic Power Systems

8492 **(DOE/NASA/20485—17) Control aspects of the Schuchuli village stand-alone photovoltaic power system.** Groumpos, P.P.; Culler, J.E.; DeLombard, R. (Cleveland State Univ., OH (USA). Dept. of Electrical Engineering; National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Nov 1984. Contract AI01-76ET20485. 31p. (NASA-TM—83790). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85000535.

The NASA Lewis Research Center is managing the Stand-Alone Application Project for the Department of Energy (DOE). Under this project, Lewis installed, in 1978, a photovoltaic power

system in an Arizona Indian village. Under a DOE funded grant from Lewis, the Energy Research Center of the Cleveland State University performed an analysis of the control subsystem of this photovoltaic power system. The four major functions of the control subsystem are voltage regulation, load management, water pump control, and system protection. This report analyzes the control subsystem functions, presents flowcharts for the control subsystem operation, and presents a computer program that models the control subsystem.

8493 **(SAND—82-7157/3) Analysis of concentrating PV-T systems for the commercial/industrial sector. Volume III. Technical issues and design guidance.** Schwinkendorf, W.E. (BDM Corp., Albuquerque, NM (USA)). Sep 1984. Contract AC04-76DP00789. 476p. NTIS, PC A21/MF A01; 1; GPO Dep. File Number DE85001199.

This report provide appropriate guidance for addressing the major technical issues associated with the design and installation of a photovoltaic-thermal (PV-T) system. Nomographs are presented for developing preliminary sizing and costing, and issues associated with specific components and the overall design of the electrical and mechanical system are discussed. SAND82-7157/2 presents a review of current PV-T technology and operating systems and a study of potential PV-T applications. Detailed PV-T system designs for three selected applications and the results of a trade-off study for these applications are presented in SAND82-7157/4. A summary of the major results of this entire study and conclusions concerning PV-T systems and applications is presented in SAND82-7157/1.

8494 **(SAND—84-0106) Photovoltaic systems development and evaluation projects integration meeting.** Thomas, M. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1984. Contract AC04-76DP00789. 234p. (CONF-840273—). NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE84008530.

From 5. photovoltaic systems development and evaluation projects intergration meeting; Albuquerque, NM, USA (14 Feb 1984).

The Fifth Annual Photovoltaic Systems Development Projects Integration Meeting was held at the Marriott Hotel, February 14, 15, and 16, 1984 in Albuquerque, New Mexico. The meeting was sponsored by Sandia National Laboratories and the United States Department of Energy. This document contains abstracts and visual materials used for the presentations as well as current contract summaries. The topics of the presentations covered System Research, the Utility and Utility Interface, Power Conditioning Development, Array Field Designs, and the Evaluation of Systems level experiments. An Issues Forum, held on the last day, focused on remaining systems issues for the Photovoltaic Program.

1407 Solar Thermal Power Systems

8495 **(SAND—84-8187) User's manual for the University of Houston individual heliostat layout and performance code.** Laurence, C.L.; Lipps, F.W. (Houston Univ., TX (USA). Energy Lab.). Dec 1984. Contract AC04-76DR00789. 235p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE85004643.

The individual heliostat (IH) computer code developed at the University of Houston determines the location of heliostats for an optimized heliostat collector field and computes in detail the performance of the central receiver system. In order for the IH code to generate optimized fields as specified by the cellwise optimization (RC) code, the IH code requires output from CELLAY. CELLAY is a stand-alone program that takes output from the RC system and generates input for the IH programs. A subroutine called LAYOUT with its associated subroutines is the primary source of heliostat location coordinates. Boundaries, slip planes, and deletes are all controlled by specification of key variables which occur before the general sequence of calculations. The IH performance code is similar to the cellwise performance code (NS) with the sum over cells being replaced by a sum over heliostats. Each heliostat has several associated quantities which are calculated and printed so that the action of the system can be monitored over the course of time. Performance can be determined at any single point in time, or it can be integrated over daily, monthly, or annual performance periods.

8496 **Rim-drive cable-aligned heliostat collector system.** Dolan, J.E.; Sands, T.D. (to Dept. of Energy). US Patent 4,466,423. 21 Aug 1984. Filed date 30 Sep 1982. vp.

PAT-APPL-429923.

Disclosed is a heliostat collector apparatus comprising at least one heliostat suspended from a plurality of longitudinally extending linkage means. An enclosure structure is disposed adjacent the heliostat and provides a means for allowing th heliostat to be substantially protected from weathering. A first drive means is operatively connected to the heliostat to effect steering thereof in at least one of first and second predetermined directions. Finally, a frame member is adapted for supporting the heliostat at an inner portion thereof. The frame includes a plurality of outer expandable portions. Each one of the expandable portions is adapted to slidably engage a corresponding one of the plurality of linkage means. The expandable portions are further adapted to allow the heliostat to be slidably moved along the linkage means in directions away from and towards the enclosure structure and to substantially reduce stress acting on the heliostat during steering.

1408 Ocean Energy Systems

8497 **(PB—84-238955) NOAA OTEC CWP (National Oceanic and Atmospheric Administration Ocean Thermal Energy Conversion Cold Water Pipe) at-sea test. Volume 3. Tabulation of the power spectra for selected channels (part 1).** (Kentron International, Inc., Honolulu, HI (USA). Honolulu Data Reduction Facility). 15 Nov 1983. 226p. NTIS, PC A11/MF A01.

See also PB84-238963.

The report is a preliminary analysis of the data collected during the Ocean Thermal Energy Conversion (OTEC) Cold Water Pipe At-Sea Test. The report includes the following items: (1) Sensor factors and offsets and the data processing algorithms used to convert the recorded sensor measurements from electrical units to engineering units. The mean, standard deviation, and root-mean-square (RMS) are tabulated for each channel converted. (2) Plots of the power spectra estimates obtained from a Fast Fourier Transform (FFT) analysis of selected channels. (3) Plots of selected sensor measurements as a function of time; and (4) Plots of bending strain along the pipe using statistics and values presented in the other volumes. The plots displaying bending strain along the abscissa axis and pipe depth along the ordinate axis. The mean, RMS, maximum, and minimum values at each depth are shown in each plot.

8498 **(PB—84-238997) NOAA OTEC CWP (National Oceanic and Atmospheric Administration Ocean Thermal Energy Conversion Cold Water Pipe) at-sea test. Volume 3. Additional tabulation of the power spectra (part 2).** (Kentron International, Inc., Honolulu, HI (USA). Honolulu Data Reduction Facility). 30 Dec 1983. 316p. NTIS, PC A14/MF A01.

See also PB84-238989.

The report is a preliminary analysis of the data collected during the Ocean Thermal Energy Conversion (OTEC) Cold Water Pipe At-Sea Test. The report includes the following items: (1) Sensor factors and offsets and the data processing algorithms used to convert the recorded sensor measurements from electrical units to engineering units. The mean, standard deviation, and root-mean-square (RMS) are tabulated for each channel converted. (2) Plots of the power spectra estimates obtained from a Fast Fourier Transform (FFT) analysis of selected channels. (3) Plots of selected sensor measurements as a function of time; and (4) Plots of bending strain along the pipe using statistics and values presented in the other volumes. The plots displaying bending strain along the abscisa axis and pipe depth along the ordinate axis. The mean, RMS, maximum, and minimum values at each depth are shown in each plot.

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 1409008493, 8753, 8784

8499 **(CONF-8409118—) Passive and hybrid solar energy update: proceedings.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Passive and Hybrid Solar Energy Div.). Oct 1984. 288p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE85003442.

From Passive and hybrid solar energy update; Washington, DC, USA (5 Sep 1984).

Separate abstracts were prepared for individual papers. (MHR)

8500 **(DOE/ET/20645—T1) Engineering field test of a solar cooling system. Topical report, Phases I and II.** (Honeywell, Inc., Roseville, MN (USA). Technology Strategy Center). Aug 1981. Contract FC02-80ET20645. 264p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE85000735.

Work on the preliminary analysis and detailed design of the solar cooling system is described. An effort of encompassing tasks requiring equipment design, equipment analysis, economic analysis of the system, and evaluation of the potential for commercialization is covered. A study of installation-related design, site-related instrumentation, system fabrication and installation, and performance-based acceptance testing is reported. Also included are preliminary and critical design reviews.

8501 **(DOE/SF/11447—T1) Active solar cooling workshop. Final report.** (Planning and Management Associates of Greater Washington, Inc., DC (USA)). Sep 1981. Contract AC03-80SF11447. 44p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85004228.

Discussions were conducted on the technology of active solar cooling, regulatory and implementation factors associated with active solar cooling, financial factors, and marketing of active solar cooling. The discussion groups, consisting of private sector and non-DOE government representatives, agreed in general that the government has some roles in the support of active cooling systems. Basically, these roles are to fund high-risk R and D, to provide for technology and information transfer, and, possibly, to accelerate the adoption of national codes and standards. Several possible studies to undertake for both systems and components were suggested. One strong recommendation was to eliminate the mandates for the utilities and let nature take its course. There was no concensus concerning incentives. (LEW)

8502 **(DOE/SF/11595—T1) Assistance in the technical support of the Active Solar Cooling Program. Final technical report.** Heitz, A.J. (Heitz Energy Engineering, Fair Oaks, CA (USA)). Mar 1983. Contract AC03-82SF11595. 86p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85002891.

Material demonstrating the nature of the work and the support activities performed are presented. The following are included: a list of active solar cooling projects, the monthly technical status reports, monthly tasks, as required tasks, and report and proposal log sheets. (MHR)

8503 **(DTH-LV-MEDD—125) International Energy Agency solar heating and cooling programme. Task 1. Investigation of the performance of solar heating and cooling systems. Simulation program validation using domestic hot water system data.** Joergensen, O. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). Aug 1982. 122p. NTIS (US Sales Only), PC A06/MF A01. File Number TI85750412.

Within Task I of the IEA Solar Heating and Cooling Programme, simulation methods for predicting the thermal performance of active solar systems have been evaluated by model-to-model comparisons and comparisons with measured performance data. The present report describes the final activity within the Task by which the predictions of the simulation models were compared to measured data from four domestic hot water systems. Ten different research groups employing a total of seven computer codes participated in this cooperative effort. The model evaluation was extended by a parameter sensitivity analysis to help further define the limits of applicability of the models. Both activities were undertaken in two rounds leading to excellent agreement in the case of validation and fine agreement in the parameter sensitivity analysis. The report describes the progress of the work and the steps taken to achieve the satisfactory end results.

8504 **(NP—5770064) Investigation of solar heated absorption-refrigeration process for the air conditioning of buildings.** Eisser, W. (Dortmund Univ. (Germany, F.R.). Abt. Chemietechnik; Deutscher Kaelte- und Klimatechnischer Verein e.V., Stuttgart (Germany, F.R.)). 1983. 194p. (In German). NTIS (US Sales Only), PC A09/MF A01. File Number TI85770064.

The consumption of primary energy in buildings can be reduced by means of the solar heated absorption refrigerator (AKM). Related to local climatic conditions, a strategy to solve the problem was developed, by which the operating behaviour of the individual system components and of the whole process can be examined, depending on the existing system parameters. Processes for calculating the part processes relevant to the system were derived. In order to describe the operating conditions of the AKM, algorithms were developed for determining the part load behaviour and cyclic method of operation. Computerized process simulation showed that with a suitable choice of size of collector and content of the store, a suitably designed solar heated AKM could provide the required amount of refrigeration in monovalent operation. Optimum operating characteristics are obtained by a solar collector system inclined at an angle of about 30° and orientated towards the south. Taking an average for the months of May to September, about 15% of incoming solar energy can be used for air conditioning purposes.

8505 **(SAND—84-1812) Solar Industrial Process Heat (IPH) Project technical report, October 1982-September 1983.** Harley, E.L.; Stine, W.B. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1984. Contract AC04-76DP00789. 159p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85004297.

This document contains a report of the work performed in the Solar Industrial Process Heat Project during FY 1983. The work involved eighteen industrial process heat experiments originally funded by the Department of Energy (DOE) under two separate programs. During FY 1983, eight of the experiments were in the operational phase directly supported by the DOE, seven had been completed previously and the solar equipment had been transferred to the plant owners for continued operation, and three had been discontinued. The report contains a description of each of the active experiments and a discussion of their system performance, operation, and maintenance experience. It also contains a brief statement of the status of the solar equipment for experiments completed in prior years. The project is sponsored by the Systems Test and Evaluations Branch of the Division of Solar Thermal Technology, Department of Energy.

1410 Solar Collectors And Concentrators

REFER ALSO TO CITATION(S) 1410008495, 8496, 8504

8506 **(CONF-8310299—1) Selective coating of stainless steel for solar collectors.** Piesslinger-Schweiger, S. (POLIGRAT G.m.b.H., Muenchen (Germany, F.R.)). 1983. 9p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number TI85770070.

From 2. international exhibition and congress on surface technology (SURTEC'83); Berlin, F.R. Germany (24 Oct 1983).

The production of a corrosion-resistant and durable selective coating of stainless steel is described. It works according to the principle of the interference filter. Properties and possibilities for use in various collector systems are described.

8507 **(CONF-8310299—2) Convection-suppressing structures for flat-plate collectors in order to improve energy conversion.** Stahl, W.; Wittwer, V. (Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Freiburg im Breisgau (Germany, F.R.). Inst. fuer Solare Energiesysteme). 1983. 3p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number TI85770071.

From 2. international exhibition and congress on surface technology (SURTEC'83); Berlin, F.R. Germany (24 Oct 1983).

Proceedings will be published by VDE-Verlag.

Solar insulation that hits the earth with a relatively low energy density can be converted into heat by means of absorption. By means of solar collectors one attempts to convey this heat with as little loss as possible to a heat transfer medium. Vacuum collectors are the most efficient but also the most expensive collectors. Flat plate collectors with selective absorbers can be improved considerably by reducing the convection between absorber and covermultiple absorber and cover. This can be achieved by means of multiple coverings or transparent structures. The disadvantages of multiple covering however is a high loss of reflection. When using structures in order to suppress convection of solar collectors coverings one must take different heat transport mechanism within the structure into account. The physical demands for high transparency in the range of solar rays, low emission in the infrared range and minimum thermal conduction are to be seen against the background of the problems of price and stability of the structure.

8508 **(CONF-8310299—3) Test methods for selective coatings transforming solar energy into thermal energy.** Schoelkopf, W. (Muenchen Univ. (Germany, F.R.). Sektion Physik). 1983. 9p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number TI85770073.

From 2. international exhibition and congress on surface technology (SURTEC'83); Berlin, F.R. Germany (24 Oct 1983).

Methods of measurement based on spectral resolution are described, i.e. ellipsometry, spectrometry and calorimetry to determine the hemispheric emissivity. These methods help to define the main characteristics of selective coatings transforming solar energy into thermal energy. However, further directional-resolution techniques must be applied for a full description of the coatings, due to the fact that the directional characteristics of reflection is a function of surface structure and wavelength.

8509 **(DOE/JPL—1060-77) Concentrator optical characterization using computer mathematical modelling and point source testing.** Dennison, E.W.; John, S.L.; Trentelman, G.F. (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Sep 1984. Contract AM04-80AL13137. 41p. (JPL-PUB—84-75). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004582.

The optical characteristics of a paraboloidal solar concentrator are analyzed using the intercept factor curve (a format for image data) to describe the results of a mathematical model and to represent reduced data from experimental testing. This procedure makes it possible not only to test an assembled concentrator, but also to evaluate single optical panels or to conduct non-solar tests of an assembled concentrator. The use of three-dimensional ray tracing computer programs to calculate the mathematical model is described. These ray tracing programs can include any type of optical configuration from simple paraboloids to arrays of spherical facets and can be adapted to microcomputers or larger computers, which can graphically display real-time comparison of calculated and measured data. The technique described herein has demonstrated that: (1) it is possible to create a model for predicting concentrator optical performance from data obtained at various points of the experimental testing process; and that (2) the intercept factor curve is a powerful format for optical performance representation - whether it is derived from the mathematical model or from experimental data.

8510 **(DOE/JPL—1060-78) Software used with the flux mapper at the Solar Parabolic Dish Test Site.** Miyazono, C. (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Sep 1984. Contract AM04-80AL13137. 63p. (JPL-PUB—84-76). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85004584.

Software for data archiving and data display was developed for use on a Digital Equipment Corporation (DEC) PDP-11/34A minicomputer for use with the JPL-designed flux mapper. The flux mapper is a two-dimensional, high radiant energy scanning device designed to measure radiant flux energies expected at the focal point of solar parabolic dish concentrators. Interfacing to the DEC equipment was accomplished by standard RS-232C serial lines. The design of the software was dictated by design constraints of the flux-mapper controller. Early attempts at data acquisition from the flux-mapper controller were not without difficulty. Time and personnel limitations resulted in an alternative method of data recording at the test site with subsequent analysis accomplished at a data evaluation location at some later time. Software for plotting was also written to better visualize the flux patterns. Recommendations for future or alternative development are discussed. A listing of the programs used in the analysis is included in an appendix.

8511 **(DOE/SF/11592—1) Site-specific research conducted in support of the Salton Sea Solar Pond Project. FY 1982 report.** French, R.L.; Marsh, H.E.; Roschke, E.J.; Wu, Y.C. (Jet Propulsion Lab., Pasadena, CA (USA)). 1 Sep 1984. Contract AI03-82SF11592. 110p. (JPL-PUB—84-68). NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85004580.

The design and operation of a salt-gradient solar pond power plant at the Salton Sea presents problems not encountered at small research ponds that have been built in the United States. The specific characteristics of the Salton Sea site and the desire to construct the pond using the local clay as a sealant represent major deviations from previous solar pond experience. This document reports on the site-specific research conducted by the Jet Propulsion Laboratory in support of the plant design. The research activity included validation of the spectrophotometric light transmission measurement technique, a search for options for clarifying the turbid and colored water of the Salton Sea, development of water clarification specifications in terms common to industry practice, quantification of gas production from microbiological reactions in the ground, a determination of the combined effects of temperature and salinity on the permeation of the local clays, and a preliminary evaluation of material corrosion.

8512 **(DOE/SF/11592—2) Salt-gradient solar ponds: summary of US Department of Energy sponsored research.** French, R.L.; Johnson, D.H.; Jones, G.F.; Zangrando, F. (Jet Propulsion Lab., Pasadena, CA (USA)). Aug 1984. Contract AI03-82SF11592. 164p. (JPL-PUB—84-74). NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85004581.

The solar pond research program conducted by the United States Department of Energy was discontinued after 1983. This document summarizes the results of the program, reviews the state of the art, and identifies the remaining outstanding issues. Solar ponds is a generic term but, in the context of this report, the term solar pond refers specifically to salt-gradient solar pond. Several small research solar ponds have been built and successfully tested. Procedures for filling the pond, maintaining the gradient, adjusting the zone boundaries, and extracting heat have been developed. Theories and models have also been developed and verified. The major remaining unknowns or issues involve the physical behavior of large ponds; i.e., wind mixing of the surface, lateral range or reach of horizontally injected fluids, ground thermal losses, and gradient zone boundary erosion caused by pumping fluid for heat extraction. These issues cannot be scaled and must be studied in a large outdoor solar pond. This report has been subdivided into three parts. Part One presents the results of the DOE research program. The major contributing institutions include Solar Energy Research Institute, Los Alamos National Laboratory, and Jet Propulsion Laboratory. Part Two presents related independent research conducted by universities. Part Three is a selected bibliography with abstracts.

8513 **(DTH-LV-MEDD—136) Solar pilot test facility. Final report - Denmark.** Ellehauge, K.; Balslev Olesen, O.; Andersen, N.B. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). Oct 1983. 90p. NTIS (US Sales Only), PC A05/MF A01. File Number TI85750413.

This report describes the work on the Danish Solar Pilot Test Facility in the period from October 1981 to June 1983. This work has been part of a "concerted action" within the project A of the solar energy programme under the Commission of the European Communities (CEC). The Solar Pilot Test Facility Group consists of participants from the following 8 member-countries: Belgium, Denmark, France, Federal Republic of Germany, Ireland, Italy, the Netherlands and the United Kingdom. In the contractual period described in this report the work on the Danish SPTF has consisted in routined collection of measurements on different system configurations. In the SPTF's there are two measuring and control installations, the SS1 and the SS2. On the SS1 installation the system has been changed to a domestic hot water system and the effect of stratification and the effect of different heat exchangers has been investigated. On the SS2 installation there has been investigated on solar systems for combined space heating and domestic hot water. Two combined systems have been mounted and the latter is to be considered as a 2. generation "ready to install" system. The investigations have been closely linked to the work in the European Modelling Group and calculations made of the Danish member of this group have formed the basis by the optimization of the system.

8514 **(LiTH-IFM-R—129) Optical properties and surface composition of oxidized copper for solar absorbers.** Roos, A.; Westerstrandh, B.; Hoernstreom, S.E.; Karlsson, S.E.; Kamf, A. (Linkoeping Univ. (Sweden). Inst. foer Fysik och Maetteknik). Jun 1983. 32p. NTIS (US Sales Only), PC A03/MF A01. File Number TI85750441.

Selectively absorbing surfaces of oxidized copper have been studied with respect to optical properties and chemical composition. Different copper qualities, preparation parameters and post-treatments have been tested and their influence on the selective properties has been evaluated. Optical and Auger analyses have been performed to characterize the oxidized copper surfaces, which have been exposed to accelerated and natural ageing. The changes in optical properties have thereby been correlated to changes in surface composition. A brushed chemically oxidized surface was found to give the best selectivity. The poorer performance of the thermally oxidized copper has been explained and a good understanding of the ageing mechanisms of the surfaces has been achieved. Among the accelerated ageing tests heat treatment was found to be the most relevant.

1420 Heat Storage

8515 **(DOE/CS/30519—1) Passive solar storage system for window manufacturers. Final technical progress report .** Brown, S.M. (Capitol Products Corp., Harrisburg, PA (USA)). 1984. Contract FC02-80CS30519. 213p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE85000432.

A thermal storage system was developed for production homes that can be produced and sold by Capitol Products, a major manufacturer of thermally broken aluminum windows. A thermal storage system comprised of 89° phase change materials was designed and tested at Capitol Products, Mechanicsburg, PA and the NAHB Research Foundation, Inc., Rockville, MD. The conclusions reached were that the product as designed can be a profitable, high volume item for Capitol Products, once technical problems with the phase change materials (PCMs) and the encapsulation are overcome. The state-of-the-art, though, was not capable of fulfilling Capitol's needs with this product.

15 GEOTHERMAL ENERGY

1502 Geology And Hydrology Of Geothermal Systems

REFER ALSO TO CITATION(S) 1502008516

1503 Geothermal Exploration And Exploration Technology

8516 **(AD-A—145662/3) Potential geothermal energy use at the Naval Air Rework Facilities, Norfolk, Va., and Jacksonville, Fla., and at the Naval Shipyard, Charleston, S.C. Interim report.** Costain, J.K.; Glover, L. III; Newman, R.W. (Naval Weapons Center, China Lake, CA (USA)). May 1984. 123p. (NWC-TP—6535). NTIS, PC A06/MF A01.

In the Navy Energy R and D Program to assess the feasibility of geothermal energy use at East Coast naval installations, the Naval Air Rework Facilities (NARFs), Norfolk, Va., and Jacksonville, Fla., and the Naval Shipyard, Charleston, S.C., were investigated. Geophysical and geological studies of the Norfolk, Jacksonville, and Charleston areas were performed, and engineering and economic factors affecting potential energy use were assessed. The Norfolk and Jacksonville NARFs are identified as candidates for geothermal systems, and system costs are predicted. Economic benefits of the proposed geothermal systems are evaluated by the net present value method of evaluating future income.

1505 Economic And Financial Aspects

REFER ALSO TO CITATION(S) 1505008712

1506 Environmental Aspects And Waste Disposal

8517 **(DOE/ET/28504—T1-Vol.1) Environmental baseline monitoring in the area of general crude oil - Department of Energy Pleasant Bayou Number 2: a geopressured geothermal test well, 1979. Annual report, Volume I.** Gustavson, T.C.; Howard, R.C.; McGookey, D. (Texas Univ., Austin (USA). Bureau of Economic Geology). 1980. Contract AS05-77ET28504. 65p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85004061.

A program to monitor baseline air and water quality, subsidence, microseismic activity, and noise in the vicinity of Brazoria County geopressured geothermal test wells, Pleasant Bayou No. 1 and No. 2, has been underway since March 1978. The initial report on environmental baseline monitoring at the test well contained descriptions of baseline air and water quality, a noise survey, an inventory of microseismic activity, and a discussion of the installation of a liquid tilt meter (Gustavson, 1979). The following report continues the description of baseline air and water quality of the test well site, includes an inventory of microseismic activity during 1979 with interpretations of the origin of the events, and discusses the installation and monitoring of a liquid tilt meter at the test well site. In addition, a brief description of flooding at the test site is presented.

8518 **(DOE/SF/11540—T2) Experimental study of electron beam induced removal of H_2S from geothermal fluids.** Helfritch, D.J.; Singhvi, R.; Evans, R.D.; Reynolds, W.E. (Cottrell Environmental Science, Somerville, NJ (USA); Ion Physics Corp., Burlington, MA (USA)). Sep 1983. Contract AC03-81SF11540. 94p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85004481.

Electric generating stations powered by geothermal steam release hydrogen sulfide fumes. The treatment of geothermal steam by electron beam irradiation is a potential alternative method of H_2S removal which can be applied upstream or downstream and has no chemical requirements. The experimental work reported here examines the effectiveness of electron beam treatment of geothermal fluids. These fluids are produced by combining the constituents in a heated cell, which contains an electron beam transpar-

ent window. Irradiation of the contents and subsequent chemical analysis allows an evaluation of effectiveness. These results are used for a commercial feasibility assessment.

1508 Geothermal Power Plants

8519 **(EGG-M—23484) Heat Cycle Reserch Experimental Program report, FY-84.** Whitbeck, J.F. (ed.). (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1984. Contract AC07-76ID01570. 21p. (CONF-8410179—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003558.

From DOE geothermal technology conference; El Centro, CA, USA (16 Oct 1984).

The Heat Cycle Research Facility (HCRF) is an experimental binary-cycle facility used to investigate different concepts and/or components for generating electrical power from a geothermal resource. This report briefly describes the Heat Cycle Research Facility in which the various tests are conducted, outlines the test program, and discusses the results obtained from the experimental program to date.

1509 Geothermal Engineering

8520 **(SAND—84-7170) Factors affecting the behavior of bentonite fluids and their in-situ conversion into cement. Final report.** Gueven, N.; Carney, L.L.; Malekahmadi, F.; Lee, L.J. (Texas Tech Univ., Lubbock (USA). Dept. of Geosciences). Nov 1984. Contract AC04-76DP00789. 139p. NTIS, PC A07/MF A01; GPO Dep. File Number DE85005141.

To develop a basic understanding of the effects of common salts, hydroxides, and other mud additives on the rheology and other functions of bentonite fluids, bentonite fluids containing these additives were autoclaved at the temperature range 70 to 600°F, and under a pressure of 17,000 psi. Subsequently, the high-temperature rheology of the fluids was measured with a FANN 50C viscometer. Other fluid properties such as plastic viscosity, gel strength, yield point, pH, CEC, and fluid losses were also determined before and after autoclaving of the fluids. The high-temperature reactions occurring in these fluids were studied with x-ray diffraction and electron microscopy. Another costly problem in drilling technology is related to the poor cement bonding of the casing to the formation. As a solution to this troublesome situation, the in-situ conversion of bentonite fluids into cement has been studied. This conversion has been successfully achieved by the addition of lime to bentonite fluids at and above 300°F.

16 TIDAL AND WAVE POWER

1607 Tidal Power Plants

8521 **(EFN-LET—1983-10) Wave data from Swedish coastal waters 1982.** Svensson, J. (Energiforskningsnaemnden, Stockholm (Sweden)). 1983. 29p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number TI85750446.

Wave measurements have during 1982 been carried out at three sites at the Swedish coast. The stations are permanent and measurements there started in 1978. This report presents plottings of wave data, and mean wave power for different wave periods. The duration of storms and of calm periods is also presented.

1608 Wave Energy Converters

REFER ALSO TO CITATION(S) 1608008521, 8525, 9060

8522 **(EFN-LET—1983-09) Wave energy - basis for planning of EFUD 84.** (Energiforskningsnaemnden, Stockholm (Sweden)). 1983. 20p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. File Number TI85750445.

Two main alternatives are discussed, a quick discontinuance and increase of research contributions, resp. potential of wind power in Sweden seems to be insufficient. The only positive effort can be the export of wave power plants. The planning group has not been able to make any recommendations for the coming three years.

8523 **(EFN-LET—1983-21) Use of wave energy for the production of electric power in Sweden.** Claeson, L. (Energiforskningsnaemnden, Stockholm (Sweden)). Mar 1983. 52p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number TI85750448.

The physical principles of wave energy and its application are treated. Technical development of wave energy conversion and environmental problems are described. A survey of international research and development is presented. According to a proposal a wave power plant by Svenska Varv AB would produce electric power at the cost of 0.25 SEK per kWh. The potential of utilizing wave power in Sweden seems to be good at a maximum of 3 to 5 TWh per year. Some 50 power plants would occupy 250 km^2 and engage 4000 yearly workers in the year 2000. Practical hints and examples are given together with a list of published reports and a presentation of the appropriate Swedish organizations.

8524 **(PB—84-237536) Experimental investigation of the harbor concept in wave energy.** Count, B.; Fry, R.; Haskell, J. (Central Electricity Generating Board, Southampton (UK). Technology Planning and Research Div.). 1982. 27p. NTIS, PC E04/MF E04.

As a result of recent cost estimates wave energy is now regarded as one of the less promising renewable technologies. However, it is possible that new avenues of research may lead to an improved cost effectiveness and one such proposal has been put forward by the Norwegian Oscillating Water Column Group. They claim that the performance of a wave energy device can be considerably improved by the addition of a harbor, which takes the form of two parallel projections (i.e. walls) extending out in front of the device, and therefore the cost effectiveness of wave energy is improved. It should be emphasized that the study described in this paper is aimed at establishing if the concept is worth pursuing, and the particular device chosen is simply a convenient research vehicle rather than a carefully scaled version of a proposed large scale system. (Copyright (c) Central Electricity Generating Board, 1982.)

17 WIND ENERGY

1701 Availability (climatology)

8525 **(EFN-LET—1983-12) Wind generated waves.** Maartensson, N. (Energiforskningsnaemnden, Stockholm (Sweden)). Sep 1982. 176p. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750447.

This thesis is a brief introduction to the theories concerning wind generated waves. It is divided into four parts. Part one discusses wave theory, its basic laws and the derivation of the wave equation. Part two deals with spectral theory, discusses Fourier analysis and transforms and their applications together with statistical wave parameters. Part three presents some wave generating mechanisms and a combination of the theories of Phillips and Miles. Part four deals with wave forecasting, fully arisen sea and the resulting spectra.

1704 Economics

REFER ALSO TO CITATION(S) 1704008527

8526 **(STEV-VIND—84-19) Semi-annual report of full-scale tests at Maglarp.** Agrell, M. (Statens Energiverk, Stockholm (Sweden)). Apr 1984. 125p. (In Swedish). NTIS (US Sales Only), PC A06/MF A01. File Number TI85750459.

The National Energy board has taken over the operation of the plant on September 22nd 1983. The full-scale tests were also started, notwithstanding the delay of the delivery of data aquisition components. The plant has delivered 1986 Mwh on to the end of 1983. The measuring system for tests will record load variations,

wind speed, disturbances etc. Lightning has struck the turbine blades, leaving circular marks. Local population has complained about TV disturbance and low frequency noise.

1705 Environmental Aspects

REFER ALSO TO CITATION(S) 1705008526, 9085

1706 Wind Energy Engineering

REFER ALSO TO CITATION(S) 1706009301

8527 **(DOE/NBM—1077) Improved models for increasing wind penetration, economics and operating reliability. Final report.** Schlueter, R.A.; Park, G.L.; Sigari, G.; Costi, T. (Michigan State Univ., East Lansing (USA). Div. of Engineering Research). Apr 1984. 198p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85000865.

The need for wind power prediction in order to enable larger wind power penetrations and improve the economics and reliability of power system operation is discussed. Methods for estimating turbulence and prediction of diurnal wind power prediction are reviewed from the literature. A method is then presented to predict meteorological event induced wind power variation from measurements of wind speed at reference meteorological towers that encircle all wind turbine clusters and from sites within the wind turbine clusters. The methodology uses a recursive least squares model and requires: (1) detection of event propagation direction; and (2) determination of delays between groups of measurements at reference meteorological towers and those measurements at towers in the array. Proper filtering of the data and methods for switching reference sites and delays for the transition from one frontal system to another is also discussed. The methodology is thoroughly tested on data from the SESAME array of meteorological towers in Oklahoma and at the Goodnoe Hills MOD-2 wind turbine cluster in Washington. The performance of the prediction methodology on data sets from both sites was quite good and indicates one or more hour ahead prediction of wind power for meteorological events is feasible.

8528 **(DTH-ABK-R—167) Inglued rods for fastening of wing-blade root section on Nibe B windmill.** Riberholt, H.; Spoeer, P. (Danmarks Tekniske Hoejskole, Lyngby. Afd. foer Baerende Konstruktioner). 1983. 79p. (In Danish). NTIS (US Sales Only), PC A05/MF A01. File Number TI85750407.

This report gives an account of the tests - static and fatigue - that gave basis for the design of the inglued rods that are used for the wingblade root section on Nibemoelle-B. Tests with four different types of designs of rods were carried out; solid, conic, grooved and hollow. The static tensile failure value for the four types of rods glued into glulam were related as 1.0:1.06:0.98:1.20. The main part of fatigue test was carried out with the hollow cylindrical rod, because it showed to be the strongest of the three last mentioned in a fatigue test at the load level 0-200 kN. A full scale test with a root section was carried out, but the results from these tests were not present when finishing this report.

8529 **(RFP—3724) Post stall airfoil data for wind turbines: wind tunnel test results.** Ostowari, C.; Naik, D. (Texas A and M Univ., College Station (USA). Dept. of Aerospace Engineering). Jul 1984. Contract AC04-76DP03533. 183p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85004052.

Wind turbine blades operate over a wide angle of attack range. Unlike aircraft, a wind turbine's angle of attack range extends deep into stall where the three dimensional performance characteristics of airfoils are not generally known. Peak power predictions upon which wind turbine components are sized depend on a good understanding of a blade's post stall characteristics. The purpose of this wind tunnel study is to characterize the performance characteristics of a blade in stall as a function of its aspect ratio, airfoil thickness and Reynolds number. This report documents results of the wind tunnel investigation of constant chord blades having four aspect ratios, with NACA 44XX series airfoil sections, at angles of attack ranging from -10 to 110°. Tests were conducted at Reynolds number ranging from one-quarter million to one million. The thickness ratios studied were 0.18, 0.15, 0.12 and 0.09. The aspect ratios were 6, 9, 12 and infinity. Results of force and pitching moment measurements, over the angle of attack range, for all combinations of Reynolds numbers, thickness and aspect ratios, and the effects of boundary layer tripping, have been presented. Both initial and secondary stall are presented. The maximum drag coefficient is found to occur at an angle of attack of 90°. The pitching moment is unstable beyond stall. The lift and post-stall drag coefficients decrease with decreasing aspect ratio. The lift coefficient decreases with decreasing thickness ratio, while the drag coefficient increases. The boundary layer tripping is observed to decrease the lift curve slope and stalling angle of attack. The drag coefficient (with tripping) is significantly affected only at low aspect ratio.

8530 **(RFP—3725) Rocky Flats Wind Energy Research Center FY 1983 annual report.** (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1983. Contract AC04-76DP03533. 73p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85004500.

The FY 1983 Annual Report for the Rocky Flats Wind Energy Research Center describes the technical and programmatic objectives, achievements, and plans for the reporting period October 1, 1982 to September 30, 1983. The research center, operated for the US Department of Energy by the Rockwell International Energy Systems Group, is a major focal point for research and testing of wind systems. Primary activities described include industry-funded and cooperative testing and analysis projects, as well as research projects in the areas of aerodynamics, structural statics and dynamics, power subsystems, and systems integration. Aerodynamic performance and load prediction codes, airfoil development and testing, conclusion of a dynamic stall investigation, and the conduct of an aerodynamics specialists workshop. Activities in the structures disciplines involved the development and validation of simple and complex structural codes, preliminary investigations of fatigue and its prediction, and an analytical study of yaw stability. Focus of power subsystems research was on the atmospheric testing of a variable speed, constant frequency generator system, with some preliminary exploration of advanced power train dynamics research. Systems integration work included the development of a new figure of merit to define the benefits of variable speed rotor operation, the publication of a simplified performance and sizing methodology, and a technology assessment. Lists of reports and papers published during the fiscal year are provided.

8531 **(RISO-M—2432) Simplified laws of similarity for wind turbine rotors.** Petersen, H. (Risoe National Lab., Roskilde (Denmark)). May 1984. 24p. NTIS (US Sales Only), PC A02/MF A01. File Number TI85750396.

Laws of similarity or scaling laws for the characteristics of a wind turbine rotor are of importance to the designer even during the initial design phase of a new wind turbine concept, but are still more so when the designer wants to make adjustments or modifications to a wind turbine, in order to improve the machine, optimize or adapt it to another wind climate than originally anticipated, or eventually redesign it by scaling up or down the rotor size. In the paper some examples are shown to illustrate the principles, and equations for the laws of similarity are derived under simplified conditions such as neglecting the influence of the variation of the Reynolds Number. Some comments are presented on comparison of stall- and pitch-regulated wind turbines and on two speed operation. The optimization of a stall-regulated wind turbine to different wind climates by variation of the generator size is illustrated by examples.

8532 **(RISO-M—2436) ABACUS. User's manual.** Gunneskov, O. (Risoe National Lab., Roskilde (Denmark)). May 1984. 39p. NTIS (US Sales Only), PC A03/MF A01. File Number TI85750397.

This report serves as a user's manual for the beam analysis program ABACUS developed by the Structural Mechanics Section. The computer program is an implementation of a beam theory developed in a series of papers collected in a forthcoming Risoe report. It is a program for static and dynamic analysis of pretwisted

beams with solid or cellular cross section having moderate wall thickness and moderate cross sectional variation. Typical applications are calculations of eigenfrequencies and mode shapes for rotor blades in axial ventilators, compressors and turbines. The program also calculated cross sectional properties and stress distributions over the cross section. The program is batch oriented and the programming language is Fortran 77. The code fully complies with the ANSI FORTRAN 77 FULL LANGUAGE STANDARD, this insuring program portability.

8533 **(SL—81238.21) Collecting of new data on existing wind energy converters.** Jensen, S.A.; Bjerregaard, E.T.D.; Paulsen, U.S. (Skibsteknisk Laboratorium, Lyngby (Denmark)). Oct 1983. 80p. NTIS (US Sales Only), PC A05/MF A01. File Number TI85750404.

A data recording system has been designed for measurements of meteorological data and data concerning the performance of a wind turbine. Measurements were carried out on two commercially available Danish wind turbines. One of the turbines was a 55 kW VESTAS wind turbine erected at a farm, and the other wind turbine was a 30 kW SONEBJERG wind turbine erected at a dwelling house. The test periods of the two wind turbines were approximately three months and two months respectively. The same measuring programme was carried out on both wind turbines. The programme included the following three types of measurements: Long-term measurements for the determination of wind statistics, power performance, and operation time; Short-term measurements for the determination of power quality, skew wind and brake functions, and finally Supervision measurements in order to record the behaviour of the wind turbine during possible emergency situation. The 55 kW wind turbine has been tested at wind speeds up to 25 m/s, whereas the 30 kW wind turbine have only encountered up to 13 m/s during the test period. The performance of both wind turbines was well documented and the energy production from the wind turbines has been compared to the energy consumption by the owners.

8534 **(STEV-VIND—84-17-Pt.1) Wind turbine HAL-3. Progress report stage 1.** Johansson, A. (Statens Energiverk, Stockholm (Sweden)). Feb 1984. 51p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number TI85750460.

The study deals with a wind power plant having a horizontal axis turbine and delivering 3 MW. At this stage, the specifications of the generator and the turbine blades are being studied. The control system is investigated separately. The aim is to propose a simple and feasible plant integrated in a group of ten units.

8535 **(STEV-VIND—84-17-Pt.2) Wind turbine HAL-3. Progress report stage 2.** Sparrentoft, K. (Statens Energiverk, Stockholm (Sweden)). Feb 1984. 38p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number TI85770104.

The study deals with a wind power plant having a horizontal axis turbine and delivering 3 MW. At this stage, the specifications of the generator and the turbine blades are being studied. The control system is investigated separately. The aim is to propose a simple and feasible plant integrated in a group of ten units.

8536 **(STEV-VIND—84-17-Pt.3) Wind turbine HAL-3. Progress report stage 3.** Ekblom, J. (Statens Energiverk, Stockholm (Sweden)). Feb 1984. 33p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number TI85770105.

The study deals with a wind power plant having a horizontal axis turbine and delivering 3 MW. At this stage, the specifications of the generator and the turbine blades are being studied. The control system is investigated separately. The aim is to propose a simple and feasible plant integrated in a group of ten units.

8537 **(STEV-VIND—84-20) Investigation of a method to control the output from a wind power induction generator by using a pulse controlled resistance connected to the rotor circuit.** Zweygbergk, S. von; Carlsson, O.; Karlsson, R. (Statens Energiverk, Stockholm (Sweden)). 1984. 28p. NTIS (US Sales Only), PC A03/MF A01. File Number TI85750458.

It is advantageous in a windmill to have a soft coupling between the wind turbine and the grid. Such a soft coupling can consist of mechanical, hydraulic or electrical elements. The aim of the present investigation has been to study the dynamical performance of a windmill with a wound rotor induction generator equipped with a controllable rotor resistance connected to the slip-rings. The advantage of such a system is that it can adjust its speed above the synchronous speed and, therefore, absorb wind gusts, reduce mechanical stresses and smooth the power output. The first part of the investigation presents a general transient analysis of the system and the calculation of some special cases. The second part describes the principle on which a test rig was built in order to verify the results of the analysis. The test rig consists of a 22 kW slip-ring induction generator with a controlled external rotor resistance. The resistance is switched on and off with a variable mark space ratio at a fixed frequency. By control of this ratio the rotor current and hence also the power output can be kept nearly constant when the mechanical torque on the shaft is varying. The rest results are in good agreement with the results obtained from the analytical calculations.

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8538 **(CONF-840414—2) Optimization of the thermodynamic cycle of a bussed cogeneration plant.** Hausmann, G. (Maschinenfabrik Augsburg-Nuernberg (M.A.N.) A.G., Nuernberg (Germany, F.R.). Unternehmensbereich Maschinen- und Stahlbau). 1984. 26p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number TI85770034.

From 1984 Hanover fair; Hanover, F.R. Germany (4 Apr 1984).

8539 **(DOE/ET/10679—T27) ESCOE Engineering Program. Combined monthly/quarterly report, March 1, 1981-May 31, 1981.** Ksander, Y. (Engineering Societies Commission on Energy, Inc., Washington, DC (USA)). Jun 1981. Contract AC22-77ET10679. 11p. (FE—2468-96). NTIS, PC A02/MF A0; 1; GPO Dep. File Number DE85003186.

This is the first combined quarterly/monthly report describing activities of the ESCOE Engineering Program. The ESCOE Engineering Program reports to the Office of Engineering and Components Management in the Department of Energy's Office of Fossil Energy. The objective of the ESCOE Engineering Program is to provide independent assessments of key portions of energy RD and D programs which are conducted by the Department of Energy. These programs are aimed at delevopment of technology that will permit rapid commercialization of processes or converting coal into products that substitute for those derived from oil and natural gas. To achieve this objective ESCOE utilizes a team of technical resident and visiting experts who come from the academic, industrial, and technical communities and who have broad experience in energy development and utilization. These Engineers in Residence are appointed for periods of about two years and must be replaced by similarly qualified people to insure that current technical information and knowledge are available to DOE. Work assignments are performed pursuant to tasks developed by the Technical Representative of DOE with the assistance of ESCOE's Executive Manager. Each Task is specific as to the work to be performed and deliverables.

8540 **(DOE/NASA—0290-01) Gas cooled fuel cell systems technology development. Final report, May 1982-May 1983.** Feret, J.M. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Energy Systems Div.). Aug 1983. Contract AI21-80ET17088. 327p. (NASA-CR—174732). NTIS, PC A15/MF A01; 1; GPO Dep. File Number DE85003811.

The work described in this report addresses the first phase of a planned multiphase program to develop a Phosphoric Acid Fuel Cell (PAFC) for Electric Utility Prototype Power Plant Application. This report describes the efforts performed that culminated in the: (1) establishment of the preliminary design requirements and system conceptual design for the nominally rated 375 kW PAFC module and is interfacing power plant systems; (2) establishment of PAFC component and stack performance, endurance, and design parameter data needed for design verification for power plant application; (3) improvement of the existing PAFC materials data base and establishment of materials specifications and process procedures for the cell components; and (4) testing of 122 subscale cell atmospheric tests for 110,000 cumulative test hours, 12 subscale cell pressurized tests for 15,000 cumulative test hours, and 12 pressurized stack tests for 10,000 cumulative test hours.

8541 (EPRI-EL—3564-SR, pp 1.1-1.9) **Generator gas monitoring system.** Gill, R.S. (General Electric Co., Schenectady, NY). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920008. (CONF-8310313—).

From EPRI workshop on generator monitoring and surveillance; Dallas, TX, USA (19 Oct 1983).

The use of core monitoring systems in detecting overheating in generators is discussed. The original core monitor alarms upon detecting pyrolysate particle products which result from the thermal decomposition of insulations and coatings. The alarm indicates that a serious, potentially damaging condition may exist within the generator and corrective action should be taken rapidly. However, other conditions, such as equipment malfunction, oil mist or decreasing gas pressure could cause an alarm. The effect of oil mist on a core monitor was satisfactorily eliminated by the development of a heated ion chamber detector design, with no loss of sensitivity in the detection of pyrolysates from overheated generator materials. Manual validation of a core monitor alarm uses valuable time during which corrective action should be taken. To expedite the validation of the core monitor alarm signal, an automatic signal validation control device was developed. Redundancy features are incorporated in the critical areas of the validation control system to assure proper operation of the instrument under conditions of component failure. Further improvements in determining the location of overheating were made by the application of tagging compounds at selected locations in the generator and the development of a pyrolysate collector which automatically collects a sample from the hydrogen gas for subsequent analysis and identification of a particular tagging compound. The operation of the gas monitoring system is discussed.

8542 (EPRI-EL—3564-SR, pp 1.11-1.23) **Torsional vibration monitoring.** Horne, B.P.; Walker, D.N. (General Electric Co., Schenectady, NY). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920008. (CONF-8310313—).

From EPRI workshop on generator monitoring and surveillance; Dallas, TX, USA (19 Oct 1983).

An overview of the development of a torsional vibration monitor system and the application of this equipment is presented. The development and testing of the on-site monitoring hardware and its companion remote computer software are discussed. Associated software for calculating turbine-generator torsional response is also described.

8543 (EPRI-EL—3564-SR, pp 1.25) **Turbine-generator supervisory instrumentation.** Sanderson, H.C. (General Electric Co., Schenectady, NY). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920008. (CONF-8310313—).

From EPRI workshop on generator monitoring and surveillance; Dallas, TX, USA (19 Oct 1983).

Supervision of about 300 generator parameters is accomplished by the Turbine-Generator Supervisory Instrumentation (TGSI). This microprocessor based system has several stations to collect data, located next to the generator, a master station for data storage, an operator panel for display request entry, and a color CRT for parameter display. Pre-programmed graphic display pages can be selected by the operator to show data for functionally related groups of sensors on the CRT. Generator parameters which can be displayed include terminal conditions, excitation electrical quantities, rotor and stator temperatures, cooling gas and water temperatures, deionized water flows and the status of various subsystem relay contacts. Generator parameters are monitored to detect alarms and data are stored periodically on a magnetic disk for rapid access and on magnetic tape for long term shortage.

8544 (EPRI-EL—3564-SR, pp 1.27-1.32) **Shorted field-turn detectors periodic diagnostic tests vs. continuous monitoring and surveillance.** Albright, D.R. (General Electric Co., Schenectady, NY). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920008. (CONF-8310313—).

From EPRI workshop on generator monitoring and surveillance; Dallas, TX, USA (19 Oct 1983).

The following questions are discussed: (1) do the present short-turn diagnostic tools meet the needs of the electric power industry, and (2) would an additional continuously operating shorted-turn monitoring system, which may not have equivalent resolution, be of value to the industry. Field winding interturn short-circuits have, although infrequently, caused operating difficulties on round rotor generators. If operating conditions develop which could be caused by shorted turns, it is desirable to be able to detect the number and location of the shorted turns so that appropriate maintenance operations can be planned. A few isolated shorted turns in a field will not cause forced outages. However, many shorted turns, such as a coil shorted out on one pole, can cause very high vibration levels which may result in a forced outage. The desirability of a high resolution continuous monitor for shorted turns to help assess whether corrective maintenance should be performed is discussed.

8545 (EPRI-EL—3564-SR, pp 1.33-1.42) **EPRI workshop on generator monitoring and surveillance.** Emery, F.T.; Lenderking, B.N. (Westinghouse Electric Corp., Orlando, FL). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920008. (CONF-8310313—).

From EPRI workshop on generator monitoring and surveillance; Dallas, TX, USA (19 Oct 1983).

The high costs of repairing generators and the loss in availability has prompted the development and use of monitors designed to detect the early stages of deterioration in generator components. Several types of monitors plus an overall monitoring system have been developed to signal if conditions indicate generator overheating or arcing. Stator coil and cooling gas temperatures are monitored to protect the stator winding components from abnormally high temperatures. Radio frequency produced in the generator neutral lead by undesired arcing inside the generator is measured to detect broken conductor strands, failed electrical joints, or reduced clearances between components at different potentials. Thermally produced particulates in the generator's cooling gas are monitored to detect developing hot spots in the insulation system. Sacrificial coatings which particulate at lower temperatures than the insulation give an even earlier warning of a developing hot spot. These monitoring techniques and others integrated into a generator monitoring system designed to provide total on-line condition monitoring of the generator are discussed.

8546 (EPRI-EL—3564-SR, pp 1.43-1.53) **Application of acoustic intensity in power plants.** McKendree, F.S. (Westinghouse Electric Corp., Pittsburgh, PA). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920008. (CONF-8310313—).

From EPRI workshop on generator monitoring and surveillance; Dallas, TX, USA (19 Oct 1983).

Acoustic intensity is a vector quantity giving the acoustic power flow per unit area in a specified direction. As such, it is a

useful quantity to measure, particularly in less than optimum acoustic environments. The general applications include sound source localization and sound power measurement. Numerous approaches have been tried in the past for the measurement of acoustic intensity, including both analog and digital techniques. The recent interest in acoustic intensity derives from the realization that two-channel FFT analyzers are capable of measuring acoustic intensity. Several recent analyzers can perform acoustic intensity measurement internally in real time. The FFT analyzers are large and relatively nonportable. Also, there are many situations in which a simple linear or A-weighted reading is all that is required. For these reasons, a portable instrument capable of measuring acoustic intensity was sought. The theory, development, and performance of a portable, self-powered, and self-contained acoustic intensity meter are discussed.

8547 (EPRI-EL—3564-SR, pp 1.55-1.62) **Evaluation of high-voltage insulation systems by partial discharge pulse testing.** Spiegl, J. (Utility Power Corp., Bradenton, FL). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920008. (CONF-8310313—).

From EPRI workshop on generator monitoring and surveillance; Dallas, TX, USA (19 Oct 1983).

Dielectric loss measurements of insulated components or completely manufactured rotating electrical machines has proven to provide valuable criteria for evaluation of mica high voltage insulation systems. During the development of the modern insulations they served as excellent tools with regard to manufacturing process or design parameter optimization and, as a reliable method, are still employed by some manufacturers to assure continuous high insulation quality. Besides the standard high-pot tests, measurements of the absolute magnitude of the dissipation factor and its increase with rising test voltage are also commonly included in acceptance tests. Since mica insulations involve a large number of minute air inclusions of different sizes with their respective partial discharge inception voltages, the resulting dielectric losses provide only summary information on a given insulation. It is not possible to discern whether individual areas have been badly impregnated or contain considerable voids when a specified limit of dissipation factor tip-up is exceeded. To detect local variations of a lengthy conductor, it has to be subdivided into several sections and measurements have to be performed for each section separately. An overview of activities regarding the measurement of partial discharge and arcing conditions in synchronous generators is given. The main objectives of these activities are the development and application of PD measurement methods for manufacturing control and during operation of insulations and the development of a more fundamental understanding of the complex discharge mechanisms.

8548 (EPRI-EL—3564-SR, pp 1.63-1.73) **Electronically tunable vibration transducer for diagnostic surveillance.** Silvus, H.S. Jr.; Swanson, R.K. (Southwest Research Inst., San Antonio, TX). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920008. (CONF-8310313—).

From EPRI workshop on generator monitoring and surveillance; Dallas, TX, USA (19 Oct 1983).

Advanced vibration analysis is a technique of early detection of defects in critical machine components based on departures from characteristic or normal machine vibrational behavior. Properly detected and analyzed, the vibration signature of a machine may be indicative of abnormal operation of its rotating components. Such an analysis may be possible even though the machine itself is a complex assortment of gears, shafts and bearings. The potential success of such flaw detection is subject to a number of variables including the accuracy with which normal vibrational behavior can be defined. Some of the practical difficulties involved in vibration analysis are discussed and a method under study at Southwest Research Institute designed to alleviate certain of these problems is described. The particular device is an electronically tunable accelerometer transducer, the purpose of which is to selectively apply peak resonant sensitivity of the accelerometer to selected portions of the vibration spectrum. The reasons for applying an accelerometer in this fashion are to improve the signal-to-noise ratio of the detected signal and to overcome problems of linearity and dynamic range that are inherent in measurement of very small signals in the presence of large overriding signals such as may exist in rotating machinery.

8549 (EPRI-EL—3564-SR, pp 2.1-2.11) **Generator monitoring practices at the Detroit Edison Company.** Corkins, R.J. (Detroit Edison Co., MI). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920008. (CONF-8310313—).

From EPRI workshop on generator monitoring and surveillance; Dallas, TX, USA (19 Oct 1983).

The basic philosophy and guidelines used for the design and implementation of generator monitoring systems at Detroit Edison are described. Monitoring systems are used to display the status of the generator and auxiliary systems while on line. For the most part, only the more modern machines are discussed.

8550 (EPRI-EL—3564-SR, pp 2.13-2.33) **Overview of generator monitoring equipment, operating experience and performance evaluation.** Hetrick, J.A.; Nilsson, N.E.; Hitchcock, T.E. (Ohio Edison, Akron). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920008. (CONF-8310313—).

From EPRI workshop on generator monitoring and surveillance; Dallas, TX, USA (19 Oct 1983).

The generator monitoring equipment employed at large Ohio Edison Company and Pennsylvania Power Company plants is described. The application philosophy is described and a summary of operating experience is presented. The effectiveness of these systems is analyzed and suggestions for future applications or refinements to present equipment are presented. Specific areas covered are as follows: generator temperature monitoring, bearing vibration monitoring, condition monitor application, miscellaneous equipment such as flux probes and operational checks, unit dedicated oscillographs, event recorders and loggers, unit data acquisition systems, and applications for future consideration.

8551 (EPRI-EL—3564-SR, pp 2.35) **Problem of rotor ground monitoring.** Waggoner, G.R. (Dallas Power and Light Co., TX). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920008. (CONF-8310313—).

From EPRI workshop on generator monitoring and surveillance; Dallas, TX, USA (19 Oct 1983).

Two different methods of generator ground detection employed by Dallas Power and Light are discussed. One method uses relays and the other zero-centered voltmeters. Suggestions are given to the manufacturers of generator protective relaying systems for improving these systems.

8552 (EPRI-EL—3564-SR, pp 2.37-2.50) **Generator radio-frequency noise monitoring system for Union Electric.** Henne, W.P.; DeSpain, D.R. (Union Electric Co., St. Louis, MO). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920008. (CONF-8310313—).

From EPRI workshop on generator monitoring and surveillance; Dallas, TX, USA (19 Oct 1983).

A system is described to monitor generators for radio-frequency noise, which is caused by arcing or corona inside the generator. The system monitors one to eight inputs, continuously, over a wide range of frequencies. Information gathered is stored on a magnetic disc, presented on a cathode-ray tube, and printed out on a printer. Outputs are provided to furnish alarms to the plant's alarm system, should the noise level increase to a level indicating a possible problem. The key feature of the system is its flexibility, permitting the operator to change alarm settings, frequencies monitored, time between scans, number of units scanned, and on demand print out readings from previous hours or days.

8553 (EPRI-EL—3564-SR, pp 2.51-2.66) **Torsional monitoring for diagnosis and surveillance utility experience.** Rusche, P.A.E. (Consumers Power Co., Jackson, MI). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920008. (CONF-8310313—).

From EPRI workshop on generator monitoring and surveillance; Dallas, TX, USA (19 Oct 1983).

Electrical phenomena can contribute to costly turbine-generator forced outages. The torsional fatigue monitor, developed to quantify accumulation of shaft mechanical fatigue due to network

disturbances, can provide information to diagnose malfunctions in the station power transfer scheme and may be useful in surveillance of excitation control systems. Features of a torsional fatigue monitor, developed for a 1000 MVA, 3600 rpm, fossil fueled, steam turbine generator, connected to minimize torsional fatigue life expenditure due to automatic reclosing practices, are described. The operating experience gained over the first two years of operation are discussed and related to a 12 year operating record of 3300 km (2070) of 345 kV circuits in the Great Lakes Region of the US. It is concluded, that (1) the raw data used in the torsional fatigue analyzer are valuable in assessing: generator (end) winding damage, and failures in the station power transfer system, (2) supplemental records of the rate of change in generator field voltage and power system stabilizer output could provide surveillance of the excitation control system, (3) on-site data analysis should be considered in addition to off-site analysis by corporate (rather than plant) staff, and (4) further work is required to capture and interpret surveillance information in excitation control systems.

8554 (EPRI-EL—3564-SR, pp 2.67-2.71) **Recent experience in generator monitoring.** Kalscheur, R.J. (Wisconsin Electric Power Co., Milwaukee). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920008. (CONF-8310313—).

From EPRI workshop on generator monitoring and surveillance; Dallas, TX, USA (19 Oct 1983).

While Wisconsin Electric is probably typical in its background of monitoring various parameters of concern (i.e., dewpoint, rotor grounds, etc.) to a limited degree, recent experience is concentrated in the monitoring of temperature and vibration along with very recent core monitoring experience using a sophisticated system to continually analyze the hydrogen cooling medium for products of corrosion and combustion. Readouts of temperature and vibration monitors have been utilized in the formulation of computer graphics to enhance operator recognition of developing problems. Some detail on each of these items is presented.

8555 (EPRI-EL—3564-SR, pp 2.73-2.94) **Monitoring moisture in hydrogen cooled generators.** Bothwell, J. (Florida Power and Light, Miami). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920008. (CONF-8310313—).

From EPRI workshop on generator monitoring and surveillance; Dallas, TX, USA (19 Oct 1983).

Moisture or water inside hydrogen cooled generators has caused a variety of problems up to and including complete rewinds. In some cases, units have tripped off on phase to ground faults and repairs were limited to only a week outage. Regardless of the magnitude of failure there is a tendency to consider the incident an isolated case which probably will never occur again or as an incident that only affects other plants or other utilities, or more often is not really examined relative to each generator because of lack of information or misunderstanding. It is this last point to which this discussion is directed. Information, insight, and thought provoking ideas are presented to provide a basis for sound judgment and evaluation of moisture in a generator situation.

8556 (EPRI-EL—3564-SR, pp 2.95-2.105) **Monitoring of generator insulation condition by measuring partial discharges.** Kurtz, M.; Lyles, J.F.; Stone, G.C. (Ontario Hydro, Toronto). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920008. (CONF-8310313—).

From EPRI workshop on generator monitoring and surveillance; Dallas, TX, USA (19 Oct 1983).

Partial discharge tests have been found useful in assessing the condition of generator stator winding insulation systems and in the early detection of incipient problems. An on-line test procedure has been developed for hydraulic generators which allows station maintenance staff to perform the test with no service interruption. This test, in use for over seven years in Ontario Hydro, has dramatically reduced the hydraulic generator winding replacement/major repair rate. The authors are now adapting this test for use on turbine-generators.

8557 (EPRI-EL—3564-SR, pp 2.107-2.111) **Ontario Hydro experience with generator core monitors.** Kapler, J.; Brown, G.; Klempner, G.S. (Ontario Hydro, Toronto). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920008. (CONF-8310313—).

From EPRI workshop on generator monitoring and surveillance; Dallas, TX, USA (19 Oct 1983).

Ontario Hydro has experienced a number of generator stator core failures in the past decade. Back of core overheating has also been and continues to be a source of concern on some units. These problems precipitated the installation of the core monitor on all generators at a large eight unit fossil-fuelled generating station. The aim of the project was to provide generator protection which would detect incipient core damage and thus, enable the repair work to be carried out on a planned maintenance basis.

8558 (EPRI-EL—3564-SR, pp 3.1-3.26) **New developments at EPRI in turbine monitoring.** McCloskey, T.H.; Parkes, J.B. (Electric Power Research Inst., Palo Alto, CA). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920008. (CONF-8310313—).

From EPRI workshop on generator monitoring and surveillance; Dallas, TX, USA (19 Oct 1983).

The increasing demand for more electrical power at competitive cost during the past several decades has resulted in a marked increase in the generating capacity of new turbine-generator units to the point where unit capacity on the order of 1000 MW is not uncommon. As has been the case with other classes of modern-day machinery, the increase in size and capacity of turbine-generator units has resulted in relatively high levels of unit failures (unplanned outages) compared to their smaller-sized processors. Moreover, the penalties, in terms of unplanned outage cost and lower power generation, are correspondingly much more severe for the larger units. The average availability of large fossil-fired power plants, with unit sizes of 600 or more, is significantly lower than for smaller plants. Statistics compiled by the Edison Electric Institute (EEI) show that during the 10-year period, 1967-1976, the average equivalent availability of such large plants was less than 68%, compared with 75% to 85% for fossil-fired plants in various smaller size categories. Statistics indicate that the reliability of these large plants have deteriorated in the past. The history of equivalent availability for large coal-fired plants; that is, those over 400 MW is shown. To counteract these problems, EPRI established the Fossil Plant Performance and Reliability Program (recently renamed the Availability and Performance Program) and within it, the Steam Turbine and Auxiliaries Subprogram. This subprogram was structured to developed technology options to reduce outages caused by generic, industrywide problems relating to the design, operation and maintenance of turbine-generators. Elements of the turbine-generators subsystem that are responsible for the largest availability losses and, therefore, have the highest researh priorities are turbine blades, bearings, rotors and solid particle erosion.

8559 (EPRI-EL—3564-SR, pp 4.1-4.3) **Break-out sessions: improvements in existing monitors.** Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920008. (CONF-8310313—).

From EPRI workshop on generator monitoring and surveillance; Dallas, TX, USA (19 Oct 1983).

Four short presentations were made in this session. They were (1) rotor ground detection, (2) core monitors, (3) radio frequency and partial discharge monitors, (4) and data logging.

8560 (EPRI-EL—3564-SR, pp 5.1-5.6) **Break-out sessions: new monitors and the application of microprocessors.** Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920008. (CONF-8310313—).

From EPRI workshop on generator monitoring and surveillance; Dallas, TX, USA (19 Oct 1983).

Five short presentations were made in this session. They were: (1) dew point monitors, (2) location specific devices, (3) expert systems, (4) field shorted turn detectors, and (5) stator flow monitors.

8561 **(EPRI-EL—3669) Reliability calculations for interdependent plant outages. Final report.** Fegan, G.R. (Energy Management Associates, Inc., Santa Clara, CA (USA)). Oct 1984. 94p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303. File Number TI85920128.

The present methods of calculating a generating system loss-of-load probability (LOLP) assume that generator forced outages are independent; that is, the forced-outage rate of 1 unit is not a function of the status of other units. In reality, the outages of generating units are not independent events, but they are a function of generator usage and maintenance schedules. The purpose of this study was to show the effects of removing the assumption of independency among unit forced outages of an electric generating system. This assumption was negated by two procedures: (a) the unit forced-outage rates were made dependent on the health of the system; that is, the number of generating-unit outages on the system and (b) the number of repair crews was constrained so that some units might have to wait for repair. Solution methods were developed to calculate system LOLP for the cases of a single change and multiple changes in forced-outage rates of generating units. Procedures were also developed for calculating the system LOLP for the case of a limited number of repair crews at a particular generating station. The study results of a hypothetical test system with 10 generating units demonstrated the degradation of forced-outage rates for individual units when unit dependencies and maintenance schedules were considered. The study pointed out the data problems and difficulties in calculating dependent forced-outage rates of generating units.

8562 **(EPRI-EL—3729-Vol.1) Optimization of reactive volt-ampere (VAR) sources in system planning. Volume 1. Solution techniques, computing methods, and results. Final report.** Lebow, W.M.; Mehra, R.K.; Nadira, R.; Rouhani, R.; Usoro, P.B.; Bhavaraju, M.P.; Pal, M.K.; Sobieski, D.W. (Scientific Systems, Inc., Cambridge, MA (USA); Public Service Electric and Gas Co., Newark, NJ (USA)). Nov 1984. 204p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $19.00. File Number TI85920147.

A two-level hierarchical approach for optimum allocation of reactive volt-ampere (VAR) sources in large-scale power system planning was developed and implemented in this project. The approach takes advantage of the natural distinction between the VAR dispatch in system operation (Level 1) and the VAR allocation in system planning (Level 2). Level 1 is an optimal power flow problem formulated as a nonlinear programming problem and solved using a projected augmented Lagrangian technique. The optimal power flow at this level can handle contingency constraints either in a corrective mode (one contingency at a time) or in a preventive mode (any one of many contingencies at a time). Level 2 is an optimal reactive source expansion problem formulated as a mixed integer-linear programming problem and solved using a branch-and-bound-type technique. The two levels are related together using the generalized Benders decomposition. The approach was implemented in the form of a prototype computer program that can efficiently optimize the location and sizes of new reactive sources in large-scale power systems (with up to 1500 buses). The results of testing the package with practical power systems of different sizes and characteristics confirm that the technique is a very valuable tool for reactive source allocation. The results of this project are contained in two volumes. Volume 1 includes solution techniques, computing methods, and results; and Volume 2 is the computer program user's manual.

8563 **Circuit breaker lock out assembly.** Gordy, W.T. (to Dept. of Energy). US Patent 4,467,152. 21 Aug 1984. Filed date 18 May 1983. vp.

PAT-APPL-495889.

A lock out assembly for a circuit breaker which consists of a generally step-shaped unitary base with an aperture in the small portion of the step-shaped base and a roughly "S" shaped retaining pin which loops through the large portion of the step-shaped base. The lock out assembly is adapted to fit over a circuit breaker with the handle switch projecting through the aperture, and the retaining pin projecting into an opening of the handle switch, preventing removal.

8564 **Mathematical modeling of fossil-fueled steam power plants under normal and emergency operating conditions.** Usoro, P.B.; Wormley, D.N. (Scientific Systems Inc., Cambridge, MA 02140). pp 6.23-6.43 of Proceedings of the fifth power plant dynamics, control and testing symposium. Vol. 1. Upadhyaya, B.R. Knoxville, TN, USA; The University of Tennessee (1983). (CONF-830318—).

From 5. power plant dynamics control and testing symposium; Knoxville, TN, USA (21 Mar 1983).

This paper presents simulation test results for a fossil-fueled drum boiler-turbine steam power plant model subjected to normal and abnormal operating conditions. The model for a prototype unit is developed using a physically based methodology presented in a companion paper and is verified using actual plant data. Three simulation tests are presented to demonstrate the response of the system to failure of major plant components and rapid changes in power demand, which frequently characterize emergency conditions.

8565 **Mathematical modeling of fossil-fueled steam power plants under normal and emergency operating conditions.** Usoro, P.B.; Wormley, D.N. (Scientific Systems Inc., Cambridge, MA 02140). pp 6.01-6.22 of Proceedings of the fifth power plant dynamics, control and testing symposium. Vol. 1 . Upadhyaya, B.R. Knoxville, TN, USA; The University of Tennessee (1983). (CONF-830318—).

From 5. power plant dynamics control and testing symposium; Knoxville, TN, USA (21 Mar 1983).

This paper presents a methodology for developing an accurate model of a fossil-fueled steam power plant which can represent the system during normal as well as abnormal operating conditions. The model is based on physical process laws and constitutive relations and with model parameters determined from geometry, material properties, and manufacturer's data. System nonlinearities are included so that the model remains valid over a wide operating range. The interaction between the mechanical and electrical components of the system are represented to permit the simulation of the power plant under conditions of abnormal voltage and/or frequency which frequently accompany emergency contingencies.

2002 Environmental Aspects

REFER ALSO TO CITATION(S) 2002008186, 8187, 8188, 8191, 8243, 8732, 8879

2003 Power Transmission And Distribution

REFER ALSO TO CITATION(S) 2003008692, 8693, 8694, 8695, 8696, 8697, 8698, 8699, 8700, 8701, 8702, 8703, 8704, 8705, 8706, 8707

8566 **(DOE/RA/50153—T1) Study of electric field and ion effects on hvdc lines. Technical progress report No. 7.** Johnson, G.B. (General Electric Co., Pittsfield, MA (USA)). Oct 1984. Contract AC02-80RA50153. 156p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85002975.

The project team was instructed to study the feasibility of conducting studies of hvdc electrical environment beyond the transmission corridor. This work was performed during the second half of 1983 and an account of the work performed is given. In addition, work was subcontracted to study the feasibility of conducting studies of human perception of the electrical environment of High Voltage Transmission Lines. An account of this work is contained in this report. A period of contract negotiations (from January 1984 to June 1984) resulted in Contract Modifications which contains the following tasks: (1) Extend techniques of measurements of electric field, ion density, and net aerosol charge to off-ground positions. (2) Develop measuring technique for the characterization of charged aerosols. (3) Calibrate the instrumentation to measure charged aerosols. (4) Measure the downwind lateral and vertical profiles of electric field, ion density, and net aerosol charge density. Measurements both at HVTRF and at the site of an operating hvdc line. (5) Study the feasibility of measuring aerosol charging and wind transport in aerosol environments other than those normally present at HVTRF or existing hvdc lines. (6) Check and validate

mathematical methods of prediction of downwind charge for monopolar hvdc lines, and (7) Support for research on human perception of fields and ions of ac and dc transmission lines.

8567 **(NP—5770043) Dynamic models of load in electrical power systems.** Reissing, T. (Dortmund Univ. (Germany, F.R.). Abt. Elektrotechnik). 23 Sep 1983. 88p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number TI85770043.

The dynamic behaviour of an electric power system is determined by the interdependence between power plants, network and loads. Modelling of the first two sub-systems, i.e. power plants and network is near-complete, but considerable work is still required on the load sector, especially in view of the fact that the dynamic processes within a network are influenced to a considerable extent by the voltage and frequency distribution of the loads. A new method is presented that requires little more numerical calculations than the solution of a load flux problem; the method permits modelling of network load behaviour and provides insight into the factors governing the sometime considerable differences between the behaviour of single loads and the total network load characteristics. The knowledge on the physical mechanism and their analysis is deepened, last but not least by the simplicity of the linear approach.

8568 **Lightning induced voltages on power lines: Theory.** Master, M.J.; Uman, M.A. (Department of Electrical Engineering, University of Florida, Gainesville, FL 32611). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Power Apparatus and Systems;* **PAS-103**: No. S, 2502-2515(Sep 1984).

Theory is presented which shows that nearby lightning return strokes can induce voltage surges of either positive or negative polarity on an overhead line depending on the location of the lightning relative to the line. The Telegraphers' Equations are solved with the return stroke vertical and horizontal electric fields as forcing functions. The horizontal electric fields are calculated from measured or assumed vertical fields and assumed earth conductivities. For a typical return stroke, voltage waveforms are presented for a line of 500 m length and one of 5 km length for the following conditions: earth conductivities between 10^{-2} mho s/m and 10^{-3} mho s/m, earth permittivities between $E = 15$ and $\Gamma = 3$, and lightning ground strike points between 0.2 km and 5.0 km of the line at a variety of positions around the line. Measured voltages on a 460 m test line described in a companion paper are compared with calculated voltage waveforms derived from measured vertical electric fields, in accordance with the developed theory. Calculated waveshapes are found to be in moderately good agreement with the measurements, but calculated magnitudes are about a factor of 4 lower than measured. Possible errors in both theory and measurement are discussed. Voltage measurements reported by other investigators are, in general, consistent with the present theory.

8569 **Lightning induced voltages on power lines: experiment.** Master, M.J.; Beasley, W.; Darveniza, M.; Uman, M.A. (Department of Electrical Engineering, University of Florida, Gainesville, FL 32611). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Power Apparatus and Systems;* **PAS-103**: No. 9, 2519-2528(Sep 1984).

The authors present correlated measurements of the voltage induced on a power line by nearby lightning and the vertical electric field intensity from that lightning. Data are given for more than 100 first strokes and more than 200 subsequent strokes with the lightning ground strike point located by triangulation using a network of television cameras and by thunder ranging. Voltages were measured at one end of a 460 m unenergized distribution line which was open-circuited at both ends. A neutral wire was located beneath the line and was grounded at both ends. The time-domain voltage and vertical electric field waveforms were detected and recorded on a system having a frequency response from less than 1 Hz to over 1 MHz. Only about half of the voltage wave forms resemble the "classical induced positive surges" described in the literature. The magnitude and polarity of the peak induced voltage is a strong function of the location of the lightning ground strike point.

8570 **Expansion planning with dispersed fuel cell power plants on actual utility systems.** Rigney, D.M.; Kekela, J.; Lee, S.T.; Pang, C.K. (Electric Power Research Institute Palo Alto, California). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Power Apparatus and Systems;* **PAS-103**: No. 9, 2388-2397(Sep 1984).

This paper presents the results of a study on the applications of fuel cell power plants (FCPPs) on actual utility systems for the period 1986-2005. Thirtyseven utilities participated in this study, and provided their actual system data and dollar values on the potential realizable benefits of applying FCPPs on their systems. A single computer model and a common set of consistent economic and technical data were used to determine the economics of installing FCPPs compared to conventional technologies for all the participating utilities. The study produced credible information on the potential applications of FCPPs on actual utility systems in terms of economic viability, capacity mix, operating modes, and factors important to system planning with FCPPs.

8571 **Distributed rectifier loads in electric power systems.** Heydt, G.T.; Grady, W.M. (School of Electrical Engineering, Purdue University, West Lafayette, Indiana). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Power Apparatus and Systems;* **PAS-103**: No. 9, 2452-2459(Sep 1984).

The level of rectifier and flourescent loads in electric power systems is often significant in localized areas. Typically, the nonlinear loads are distributed over many distribution and subtransmission busses. In this paper, the harmonic signal levels resulting from distributed rectifier loads are examined using a recently reported harmonic power flow study algorithm. Because the algorithm does not rely on superposition or sinusoidal bus voltage assumptions, it may be applied in cases of high harmonic content such as nearresonant conditions. A case history is presented and examination of alternative methods of harmonic attenuation is presented. Also, for six pulse, line commutated rectifiers, the effect of dc circuit load variation and dc circuit inductance on harmonic signal levels is examined.

8572 **Electronically controlled cable wrapper.** Young, Th.M. (to Dept. of Energy). US Patent 4,463,547. 7 Aug 1984. Filed date 17 Aug 1982. vp.

PAT-APPL-408998.

A spindle assembly engages and moves along a length of cable to be wrapped with insulating tape. Reels of insulating tape are mounted on a outer rotatable spindle which revolves around the cable to dispense insulating tape. The rate of movement of the spindle assembly along the length of the cable is controlled by a stepper motor which is programmably synchronized to the rate at which rotatable spindle wraps the cable. The stepper motor drives a roller which engages the cable and moves the spindle assembly along the length of the cable as it is being wrapped. The spindle assembly is mounted at the end of an articulated arm which allows free movement of the spindle assembly and allows the spindle assembly to follow lateral movement of the cable.

8573 **Operation of a long-term transient monitoring system in a 138-KV and a 500-KV substation.** Perkins, M.D.; Mauser, S.F.; Mikell, D.C.; Nilsson, S.L. (Westinghouse Electric Corp., Pittsburgh, PA). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Power Apparatus and Systems;* **PAS-103**: No. 8, 2283-2289(Aug 1984).

This paper describes the operating performance of automatic transient monitoring laboratories designed to capture fault and transient data on power systems. Laboratories were installed in a 138-kV and a 500-kV substation and operated for more than 25,000 hours over a three-year period. Recorded during this period were 341 events consisting of lightning, switching, and fault transients. These results provide invaluable data on actual transients in power systems to aid power system equipment designers.

8574 **Microcomputer control of power converters.** Alegria, C.M.; Freris, L.L.; Paiva, J.P. (Instituto Superior Tecnico, Lisbon). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Power Apparatus and Systems;* **PAS-103**: No. 8, 2011-2017(Aug 1984).

Thyristor power converters are charac terized by an inherent discrete control action and are, therefore, particularly well suited to on - line control by microcomputers. The paper presents a new design of digital controllers based upon powerful 16-bit or bit - slice microprocessors, which provide high firing time resolution and enough computing power to implement sophis ticated control strategies. Both hardware and software are discussed, with special emphasis on the firing con trol algorithms. The properties of Pulse Frequency Con trol (PFC) and Pulse Phase Control (PPC) are examined and small-signal discrete models are presented. These models are used in the analysis of constant current and constant extinction angle control through the z-transform method.

8575 **The integration of HVDC subsystems into the harmonic power flow algorithm.** Song, W.; Grady, W.M.; Heydt, G.T. (Electric and Automation Engineering Department, Tianjin University, Tianjin). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Power Apparatus and Systems;* **PAS-103**: No. 8, 1953-1960(Aug 1984).

This paper is an extension of recent work done in harmonic power flow studies. The extension is inclusion of HVDC subsystems. An example using six pulse converters is given. Also, a simplification to the harmonic power flow algorithm is presented based on the accuracy of the fundamental frequency solution in the absence of nonlinear loads.

8576 **The 60 HZ performance of superconducting power transmission cables rated for 333 MVA per phase.** Forsyth, E.B. (Brookhaven National Laboratory, Associated Universities Inc., Upton, New York 11973). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Power Apparatus and Systems;* **PAS-103**: No. 8, 2023-2033(Aug 1984).

For the past year two 115 meter-long superconducting power transmission cables have been tested at Brookhaven. These cables are the culmination of about a decade of development and are the largest application of superconductivity to power engineering up to the present. Performance data for 60 Hz excitation up to 6000 A and 110 kV are given.

8577 **Summary of transient data obtained from long-term monitoring of a 138-KV and A 500-KV transmission line.** Perkins, M.D.; Mauser, S.F.; Mikell, D.C.; Nilsson, S.L. (Westinghouse Electric Corp. Pittsburgh, PA). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Power Apparatus and Systems;* **PAS-103**: No. 8, 2290-2298(Aug 1984).

This paper presents a summary of transient data obtained during the monitoring of voltages and currents for a 138-kV and a 500-kV transmission line. The 341 transient events recorded during staged tests and unattended operation are grouped into three classes--lightning, switching, and fault. Significant examples are discussed in detail, and sample waveforms are presented. A description of the laboratories used to make the measurements is included in a companion paper. This work was sponsored by the Electric Power Research Institute under Contract RP751-1.

21 NUCLEAR POWER PLANTS

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 2101008395, 8613, 8618, 8625, 8626, 8628, 8629, 8632, 8633, 8634, 8648, 8651, 8656, 8657, 8659, 8660

8578 **(BNL-NUREG—35428) Environmental factors influencing stress corrosion cracking in boiling water reactors.** Weeks, J.R. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 26p. (CONF-8409188—1). NTIS, PC A03/MF A01 - GPO. File Number TI85003205.

From EFC-ACHEMA meeting on environment sensitive cracking problems in nuclear installations containing high temperature water; Munich, F.R. Germany (17 Sep 1984).

The mechanisms of intergranular stress corrosion cracking (IGSCC) of sensitized stainless steels in boiling water reactor (BWR) primary coolant are reviewed, with emphasis on the role the environment plays on both the initiation and propagation processes. Environmental factors discussed include oxygen (corrosion potential), temperature, and dissolved ions in the water and the range of strain rates at which IGSCC occurs. Both crack propagation rates and the range of strain rates at which IGSCC occurs decrease rapidly as temperature is increased above approximately 200°C, in essentially the same manner as the solubility of magnetite decreases in acidic solutions. A mechanism of crack propagation is presented base on this observation. To establish water chemistry guidelines for crack-free operation of BWR's containing sensitized stainless steel, more information is needed on the role of absorption of impurities in the surface and deposited oxides and on the interaction between the oxygen and impurity levels required to maintain an electrochemical potential in a range where IGSCC is unlikely to occur. The relative effects of short bursts of impurities and longer term lower concentrations of these same impurities also need to be evaluated.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 2102008395, 8602, 8612, 8613, 8616, 8617, 8621, 8624, 8627, 8628, 8630, 8631, 8635, 8640, 8641, 8643, 8648, 8656, 8658, 8660, 8662

8579 **(BNL-NUREG—35280) MINET validation study using steam generator test data.** Van Tuyle, G.J.; Guppy, J.G. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 7p. (CONF-841115—5). NTIS, PC A02/MF A01 - GPO; GPO Dep. File Number TI85001224.

From International conference on power plant simulation; Mexico City, Mexico (19 Nov 1984).

Three steam generator transient test cases that were simulated using the MINET computer code are described, with computed results compared against experimental data. The MINET calculations closely agreed with the experiment for both the once-through and the U-tube steam generator test cases. The effort is part of an ongoing effort to validate the MINET computer code for thermal-hydraulic plant systems transient analysis, and strongly supports the validity of the MINET models.

8580 **(CONF-841017—3) Behavior of neutron noise during the first and second fuel cycles of Sequoyah-1 PWR.** Sweeney, F.J.; Smith, C.M.; March-Leuba, J. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA)). 1984. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85002476.

From Specialists' meeting on reactor noise - SMORN IV; Dijon, France (15 Oct 1984).

Ex-core neutron detector noise has been utilized extensively to monitor core support barrel (CSB) vibrations. Previous studies have found that only moderate increases in neutron noise normally occur over a fuel cycle in the frequency ranges associated with

CBS motion. In order to observe long-term changes in the neutron noise under varying conditions, noise signals at Sequoyah-1, a Westinghouse 1150-MW(e) pressurized water reactor (PWR), were monitored continuously during the entire first fuel cycle and approximately three months of the second fuel cycle.

8581 **(DLCS—5000384) [Shippingport Atomic Power Station]. Quarterly operating report, third quarter 1984 .** (Duquesne Light Co., Pittsburgh, PA (USA)). Oct 1984. Contract AC11-76PN00292. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85000024.

At the beginning of the third quarter of 1984, the Shippingport Atomic Power Station remained shut down for end of life defueling and decommissioning. The fuel handling canal remained full of borated water. Reactor plant system inactivation and turbine plant salvage operations continued during the quarter. Defueling efforts continued with two fuel shipments made to the Expended Core Facility in Idaho. Defueling activities for the quarter are summarized.

8582 **(DOE/ET/34212—44) Characterization and irradiation program: extended-burnup gadolina lead test assembly (Mark GdB).** Newman, L.W. (Babcock and Wilcox Co., Lynchburg, VA (USA)). Nov 1984. Contract AC02-78ET34212;AC02-78ET34213. 69p. (BAW—1817). NTIS (US Sales Only), PC A04/MF A01; 1; GPO Dep. File Number DE85005147.

This advanced fuel assembly uses a UO_2-Gd_2O_3 fuel burnable-absorber mixture along with other state-of-the-art fuel performance and uranium utilization-enhancing design features that include annular pellets, annealed guide tubes, Zircaloy intermediate grids, and a removable upper end fitting. Goal of the program is to extend the burnup of pressurized water reactor fuel assemblies to 50,000 MWd/mtU batch average burnup. To achieve this goal, five lead test assemblies have been designed, manufactured, characterized, and inserted for irradiation in Oconee Unit 1 cycle 8. One lead test assembly will receive 13,989 MWd/mtU burnup by its discharge at the end of cycle 8. Three of the four remaining lead test assemblies will receive approximately 45,000 MWd/mtU burnup by their discharge at the end of cycle 10. The fourth lead test assembly will receive approximately 58,000 MWd/mtU before being discharged at the end of cycle 11. The lead test assemblies and their constituent components have been extensively characterized to acquire a beginning-of-life data base to compare with future post-irradiation examination results and thereby determine the irradiation performance of the assemblies and their components. This report contains a description of the lead test assemblies and the pre-irradiation characterization data. Also, the plans for irradiating and examining these assemblies are discussed.

8583 **(EPRI-NP—3780) Analysis of Oconee Unit 1 downcomer and lower plenum thermal-mixing tests using COMMIX-1A. Final report.** Lyczkowski, R.W.; Fohs, H.P.; Baumann, W.L.; Domanus, H.M.; Sha, W.T. (Argonne National Lab., IL (USA)). Nov 1984. Contract W-31-109-ENG-38. 66p. NTIS, PC A04/MF A01; 1 - EPRI; GPO Dep. File Number DE85003281.

This report presents the results of three-dimensional steady-state computations using COMMIX-1A for the analysis of thermal mixing tests performed in the OCONEE-1 PWR at the beginning of fuel cycle 6 early in 1980 under EPRI sponsorship. It was found that detailed modeling of the 52 asymmetrically located instrument guide tubes together with the various structures in the lower plenum yielded generally good agreement with the data (within 1°F). Most of the thermal mixing trends at the entrance to the core and midplane deduced from the 29 thermocouple reading were correctly computed by COMMIX-1A.

8584 **(GEND-INF—058) Irradiation test report: Foxboro E11GM, Bailey BY3X31A, and flame retardant ethylene propylene instrumentation cable.** Yancey, M.E. (EG and G Idaho, Inc., Idaho Falls (USA)). Aug 1984. Contract AC07-76ID01570. 26p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85003944.

This report summarizes the results of a test program designed to resolve whether or not pressure transmitters located on the core flood tanks at Three Mile Island Unit 2 (TMI-2) during the accident of March 28, 1979 performed within their calibration limits during the periods of high radiation. Two Foxboro transmitters and one Bailey transmitter, each with associated cabling, were subjected to irradiation at a test facility at INEL. The irradiation test was designed to simulate, as closely as possible, the accident conditions experienced on the actual transmitters at TMI. The Bailey Meter Co. transmitter exhibited a definite sensitivity to total integrated dose (TID) of radiation with a 4% zero shift at 5.5×10^4 R TID and increasing to 16% at 5.4×10^6 R TID. The Foxboro units had negligible shift. The associated cabling exhibited a change in insulation resistance of -10% at 1.35×10^7 R TID.

8585 **(GKSS—84/E/18) Thermal fluid-structure interaction - a few scaling considerations.** Dimitrov, B.; Schwan, H. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1984. 37p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85750108.

Scaling laws for modeling of nuclear reactor systems primarily consider relations between thermalhydraulic parameters in the control volumes for the model and the prototype. Usually the influence of structural heat is neglected. This report describes, how scaling criteria are improved by parameters concerning structural heat, because during thermal transients there is a strong coupling between the thermalhydraulic system and the surrounding structures. Volumetric scaling laws are applied to a straight pipe of the primary loop of a pressurized water reactor (PWR). For the prototype pipe data of a KWU standard PWR with four loops are chosen. Theoretical studies and RELAP 5/MOD 1 calculations regarding the influence of structural heat on thermalhydraulic response of the fluid are performed. Recommendations are given for minimization of distortions due to influence of structural heat between model and prototype.

8586 **(ORNL/CSD/TM—218) Effect of boron and gadolinium concentration on the calculated neutron multiplication factor of $U(3)O_2$ fuel pins in optimum geometries.** Thomas, J.T. (Oak Ridge National Lab., TN (USA)). Oct 1984. Contract AC05-84OR21400. 74p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85003793.

The KENO-Va improved Monte Carlo criticality program is used to calculate the neutron multiplication factor for TMI-U2 fuel compositions in a variety of configurations and to display parametric regions giving rise to maximum reactivity contributions. The lattice pitch of UO_2 fuel pins producing a maximum k/sub eff/ is determined as a function of boron concentrations in the coolant for infinite and finite systems. The characteristics of U_3O_8-coolant mixtures of interest to modeling the rubble region of the core are presented. Several disrupted core configurations are calculated and comparisons made. The results should be useful to proposed defueling of the TMI-U2 reactor.

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 2103008642, 8650, 8653

8587 **(Juel—1906) Design of the inner reflector of a high-temperature gas-cooled reactor.** Theymann, W.; Delle, W.; Nickel, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorwerkstoffe und Heisse Zellen; Technische Hochschule Aachen (Germany, F.R.)). Mar 1984. 122p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE85750103.

Graphite undergoes considerable changes in its physical and mechanical characteristics when exposed to fast neutrons and high temperatures in the High-Temperature Reactor core. The inner reflector, which is situated adjacent to the core, is designed for this type of material behaviour. Depending on the loading, the geometrical layout and the engineering design are defined by the special characteristics of graphite. The dimensional criteria are set by the integrity of the reflector blocks. In the event of extremely high neutron fluences, wear of the reflector block surface adjacent to the core is allowed.

8588 **(Juel—1912) Theoretical and experimental research of natural convection in the core of the high temperature pebble bed reactor.** Schuerenkraemer, M. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung; Technische Hochschule Aachen (Germany, F.R.)). Apr 1984. 118p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE85750102.

The physical model of the developed THERMIX-2D-code for computing thermohydraulic behaviour of the core of high temperature pebble bed reactors is verified by experiments with natural convection flow. Such fluid flow behaviour can be of very high importance for the real reactor in the case of natural heat removal decay. The experiments are performed in a special set up testing-stand with pressures up to 30 bars and temperatures up to 300°C by using air and helium as fluid. In comparison with the experimental data the numerical results show that a good and useful simulation is given by the program. Pure natural convection flow in packed pebble beds is calculated with a very high degree of reliability. The investigation of flow stability demonstrate that radial-symmetric relations are not given temporarily when national convection is overlayed by forced convection flow. In the discussion it is explained when and to what extent the program leds to useful results in such situations. The test of the effective heat conductivity lambdasub(eff) results in an improvement of the lambdasub(eff)-data used so far for temperatures below 1300°C.

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 2105008644, 8902, 8927

8589 **(HEDL-SA—3067-FP) Coatings for fast breeder reactor components.** Johnson, R.N. (Hanford Engineering Development Lab., Richland, WA (USA)). Apr 1984. Contract AC06-76FF02170. 44p. (CONF-8404135—6). NTIS, PC A03/MF A01; GPO Dep. File Number DE85000863.

From International conference on metallurgical coatings; San Diego, CA, USA (9 Apr 1984).

Several types of metallurgical coatings are used in the unique environments of the fast breeder reactor. Most of the coatings have been developed for tribological applications, but some also serve as corrosion barriers, diffusion barriers, or radionuclide traps. The materials that have consistently given the best performance as tribological coatings in the breeder reactor environments have been coatings based on chromium carbide, nickel aluminide, or Tribaloy 700 (a nickel-base hard-facing alloy). Other coatings that have been qualified for limited applications include chromium plating for low temperature galling protection and nickel plating for radionuclide trapping.

8590 **(HEDL-SA—3146-FP) Fuel pellet fissile content variation in as-sintered fast reactor fuel.** Powers, H.G.; Dutt, D.S. (Hanford Engineering Development Lab., Richland, WA (USA)). 24 May 1984. Contract AC06-76FF02170. 9p. (CONF-841105—39). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003009.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; Washington, DC, USA (11 Nov 1984).

Previous studies have shown that a substantial reduction in the manufacturing costs of liquid metal fast breeder reactor fuel can be achived by a relaxation in the mixed uranium/plutonium oxide fuel pellet tolerance specification consistent with demonstrated process capabilities for as-sintered fuel. A number of studies were required to confirm that the proposed relaxations would not be detrimental to reactor core performance. One such study, which compared the expected variability of local fuel pellet fissile content with that allowed based upon reactor performance criteria, is reported herein.

2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

8591 **(NAA-SR-Memo—12424) Tensile testing of irradiated SNAP cladding (Hastelloy-N).** Krupp, W.E.; Harris, J.M. (Atomics International, Canoga Park, CA (USA)). 23 Aug 1967. 52p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85004474.

Uniaxial tensile tests were conducted to determine the ductility remaining in fuel element cladding following irradiation. A total of 32 tests were conducted at 1400°F and 0.002 in./min, yielding an average ductility of 0.85%. A total of four tests were conducted at 1200°F and 0.002 in./min, yielding an average ductility of 2.7%. Metallographic examination of eight specimens tensile tested at 1400°F indicated intergranular failures, while examination of two specimens tensile tested at 1200°F indicated transgranular failure across the bulk of the specimens, with intergranular failure observed at both edges. Methods were developed to directly prepare tensile specimens from the cladding of SNAP fuel elements, and to tensile test these specimens in-cell, using an extensometer to measure strain.

2107 Regulation And Licensing

REFER ALSO TO CITATION(S) 2107008594, 8651

8592 **(NUREG—0390-Vol.7-No.2) Topical report review status. Volume 7, No. 2.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Resource Management). Nov 1984. 211p. NTIS, PC A10/MF A01 - GPO*. File Number TI85900438.

Purpose of this document is to provide periodic progress reports of on-going topical report reviews, to identify those topical reports for which the NRC staff review has been completed and those which are under review and to provide NRC management with sufficient information regarding the conduct of the topical report program to permit taking whatever actions are deemed necessary or appropriate. This document is also intended to be a source of information to NRC Licensing Project Managers and other NRC personnel regarding the status of topical reports which may be referenced in applications for which they have responsibility.

2108 Economics

REFER ALSO TO CITATION(S) 2108008611

22 NUCLEAR REACTOR TECHNOLOGY

2201 Theory And Calculation

REFER ALSO TO CITATION(S) 2201008426

8593 **(NUREG/CR—4028) Unified theory for predicting maximum fluid particle size for drops and bubbles.** Kocamustafaogullari, G.; Chen, I.Y.; Ishii, M. (Argonne National Lab., IL (USA)). Oct 1984. Contract W-31-109-ENG-38. 48p. (ANL—84-67). NTIS, PC A03/MF A01 - GPO. File Number TI85000406.

Disturbances which cause fluid particle splitting are classified as rapid accelerations, high shear stresses and turbulent fluctuations in the continuous fluids. However, it has been observed that even when none of such external disturbances is present, there is a limit to the size to which drops and bubbles can reach. The maximum size attained by single bubbles or drops rising or falling freely through a stagnant media in the absence of such disturbances has been traditionally attributed to the instability of Rayleigh-Taylor instability, which does not take into acount the effects of relative motion. Based on the Kelvin-Helmholtz instability theory which allows a relative motion at the interface, a simple model is developed to describe the breakup of drops and bubbles falling or rising through a fluid. Breakup is predicted to occur if the growth of dis-

turbances on the leading front is rapid enough relative to the propagation rate of disturbances around the interface. Based on this theoretical model and available experimental data, a simple correlation is developed to predict the maximum stable particle size in a fluid. Predicted values of the maximum particle size are compared with experimental data for cases of bubbles in liquid, drops in liquid, and drops in gas. Agreement between the model and experimental results is favorable.

8594 **(PNL-SA—12053) Allowable residual contamination levels for decommissioning, Part 2: a summary of example results.** Kennedy, W.E. Jr.; Napier, B.A. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1984. Contract AC06-76RL01830. 10p. (CONF-841187—7-Pt.2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003632.

From 5. DOE environmental protection information meeting; Albuquerque, NM, USA (6 Nov 1984).

This paper contains a description of the results of a study sponsored by UNC Nuclear Industries to determine Allowable Residual Contamination Levels (ARCL) for decommissioning facilities in the 100 Areas of the Hanford Site. ARCL results are presented both for surface contamination remaining in facilities (in dpm/100 cm^2) and for unconfined surface and confined subsurface soil conditions (in pCi/g). Two confined soil conditions are considered: contamination at depths between 1 and 4 m, and contamination at depths greater than or equal to 5 m. A set of worksheets are discussed for modifying the ARCL values to accommodate changes in the radionuclide mixture or concentrations, to consider the impacts of radioactive decay, and to predict instrument responses. Finally, a comparison is made between the unrestricted release ARCL values for the 100 Area facilities and existing decommissioning and land disposal regulations. For surface contamination, the comparison shows good agreement for a selected annual dose limit. For soil contamination, the comparison shows good agreement if reasonable modification factors are applied to account for the differences in modeling soil contamination and licensed low-level waste.

8595 **(RIG—16) Progress report, 1982-1983.** (Verein zur Foerderung der Anwendung der Kernenergie, Graz (Austria). Reaktorinstitut). Apr 1984. 29p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number TI84703480.

The report gives an overview of work done in the fields of plasma physics, neutron physics and reactor physics. The results are contained in journal publications, dissertations and theses already published or to be published shortly.

8596 **(ORNL-tr—5170) Changes in the UNIMUG code (Addendum to Technical Note EAV/NT-003/80).** Alcantara, H.G.; Rosa, M.A.P. (Oak Ridge National Lab., TN (USA); Centro Tecnico Aeroespacial, Sao Jose dos Campos (Brazil). Inst. de Estudos Avancados). [1985]. Contract AC05-84OR21400. Translation of IEAv/RI/001/ENU/83. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003763.

With the insertion of new subroutines, the UNIMUG-VERSION 3 code will have options for condensing macroscopic and microscopic collision cross sections in the regions of the component isotopes in each region. It also allows calculation of the spectral indices, the ratio between two specific reactions of the isotopes selected in the groups and regions indicated. And it calculates the mean BUCKLING per region/group, per region, as well as the mean BUCKLING and fluxes from the reactor. With the introduction of dynamic allocation in memory, it increases the UNIMUG code, the ALOCDIN deck with the subroutines INICIA, POE, MOVE, STATUS and the LOC function. Moreover, the main program is divided into two subroutines: STATIC and VENENO (poison). The dynamic allocation memory makes it possible to move all the variables from the program using random storage on disk (MASS STORAGE-MS) thus eliminating the restrictions as to the number of regions, number of groups, number of intervals and length of the table of macroscopic and microscopic collision cross sections.

2202 Components And Accessories

REFER ALSO TO CITATION(S) 2202008638, 8639

8597 **(EGG-M—19784) MATPRO (materials properties) code development.** Hagrman, D.L. (EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 15p. (CONF-8410142—53). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003408.

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

MATPRO is a handbook and collection of computer subcodes that describe more than 100 materials properties of light water reactor (LWR) fuel and control rods and associated materials. Properties are given for oxide fuels, fuel rod cladding, cladding oxide layers, neutron absorbers, control rod cladding, grid spacers, fuel-cladding-oxygen compounds, and gap-gas mixtures materials properties.

8598 (EPRI-EL—3564-SR, pp 3.27-3.42) **Nuclear Power Division activities in monitoring.** Shugars, H.G. (Electric Power Research Inst., Palo Alto, CA). Aug 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920008. (CONF-8310313—).

From EPRI workshop on generator monitoring and surveillance; Dallas, TX, USA (19 Oct 1983).

The Nuclear Division of EPRI is sponsoring several projects to develop monitoring and diagnostics for components and systems. The purposes of the projects are to warn plant operators of developing failures and to help plant maintenance staffs plan their work more effectively. The projects discussed in the workshop addressed monitoring of auxiliary equipment, valves, diesel generators, piping, radiation and plant chemistry. Viewgraphs that summarize the projects are presented.

8599 **(NUREG/CR—3911-Vol.1) Evaluation of welded and repair-welded stainless steel for LWR-service. Quarterly report, January-March 1984. Volume 1.** Atteridge, D.G.; Bruemmer, S.M.; Page, R.E. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1984. Contract AC06-76RL01830. 29p. (PNL—5181-Vol.1). NTIS, PC A03/MF A01 - GPO $3.75. File Number TI85003998.

Stainless steels often become sensitized, or less resistant to stress corrosion cracking (SCC), after undergoing heating and cooling cycles such as those encountered in welding. The weld heat-affected zone (HAZ) is often the site of crack initiation. This program will therefore measure and model the development of a sensitized microstructure and its resultant resistance to SCC in welded and repair-welded stainless steel pipe. The result will be a method to assess the effects of welding variables on the SCC susceptibility of component-specific nuclear reactor welds/repairs.

8600 **(NUREG/CR—3918) Evaluation of welded and repair-welded stainless steel for Light Water Reactor (LWR) service. Compositional effects on the sensitization of austenitic stainless steels.** Bruemmer, S.M.; Charlot, L.A.; Atteridge, D.G. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1984. Contract AC06-76RL01830. 73p. (PNL—5186). NTIS, PC A04/MF A01 - GPO $4.50. File Number TI85005002.

A program is being conducted to develop validated models for the prediction of stress corrosion cracking susceptibility in the heat-affected zone of stainless steel weldments. This report reviews the effects of alloying and impurity elements on the sensitization propensity of Types 304 and 316 stainless steel. As expected, carbon was found to be the dominant element controlling sensitization, with chromium, molybdenum, and nickel also important. Other alloying elements, such as manganese and silicon, have at most only a small effect on sensitization. However, strongly segregating elements, such as nitrogen, boron, and phosphorus, may have a significant effect on intergranular corrosion and stress corrosion cracking susceptibility.

2203 Fuel Elements

8601 (EGG-M—07484) Preliminary study of oxidation-resistant coatings on refractory-metal thermocouple sheaths. Wilkins, S.C. (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1984. Contract AC07-76ID01570. 8p. (CONF-8409109—6). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003436.

From Industrial temperature measurement symposium; Knoxville, TN, USA (10 Sep 1984).

The need to make reliable temperature measurements up to 2200°C or higher in steam environments during in-pile nuclear fuel damage tests led to a search for oxidation-resistant coatings for the refractory-metal sheaths used to enclose and protect thermocouples used for such measurements. Iridium, thoria, and thoria-over-iridium coatings were separately sputter-deposited on molybdenum-rhenium alloy protection tubes for evaluation. The coated samples were individually heated in flowing steam in an induction furnace. An extension tube welded to each sample was connected to a vacuum pump and gauge; failure of the sample was detected by noting the degradation of the vacuum maintained in the sample. Relatively heavy coatings of iridium provided a modest degree of oxidation protection at the temperatures of interest. Thoria coatings provided no significant protection at those temperatures, compared to uncoated control samples.

2204 Control Systems

8602 (BMI—1984-046) Safety analysis of the software of the power density limiting computer (DNB-module) at Grafenrheinfeld. Kersken, M. (Bundesministerium des Innern, Bonn (Germany, F.R.). Abt. Reaktorsicherheit und Strahlenschutz; Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Jul 1984. 159p. (In German). (GRS-A—894). NTIS (US Sales Only), PC A08/MF A01. File Number TI85750109.

This report starts with a brief description of the computer system used in Grafenrheinfeld for limiting the power density in the reactor core (DNB-Module) and is then followed by a discussion on methods for verification of the systems' software. The different language levels on which analysis may be performed are presented and criteria for choosing the appropriate language level with regard to verification are given. The program analysis splits the software into sections which are manageable and testable. Then the detailed structure of control flow and data flow as well as the functional properties of these sections are investigated. On certain premises completely analysed sections can be regarded as error free, i.e. their failure probability can be assumed to be zero. In addition, test cases for the various software sections are established on the basis of the program analysis. The test strategy comprises the module (sectional) test, partially performed with the test cases mentioned above, as well as an integration test of the entire DNB software. Both tests may be performed automatically - the test embedment is already established to a certain extent - thus allowing execution of a great number of tests; a feature which is extremely important in view of an assessment of quantitative software parameters.

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 2206008622, 8662

8603 (DOE/ER/03409—2) Twenty-ninth annual progress report of the Pennsylvania State University Breazeale Nuclear Reactor, July 1, 1983-June 30, 1984. Levine, S.H.; Totenbier, R.E. (Pennsylvania State Univ., University Park (USA). Dept. of Nuclear Engineering). Jul 1984. Contract AC02-76ER03409. 80p. (PSBR—315-4984100). NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85002398.

The twenty-ninth annual progress report of the operation of the Pennsylvania State University Breazeale Reactor is submitted in accordance with the requirements of Contract DE-AC02-76ER03409 with the United States Department of Energy. This report also provides the University administration with a summary of the operation of the facility for the past year.

8604 (EGG-M—25583) Niobium neutron fluence dosimeter measurements. Gehrke, R.J.; Rogers, J.W.; Baker, J.D. (Idaho National Engineering Lab., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 19p. (CONF-840902—18). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003406.

From 5. ASTM-Euratom symposium on reactor dosimetry; Geesthacht, F.R. Germany (24 Sep 1984).

The use of the ^{93}Nb(n,n')/sup 93m/Nb reaction to monitor fast neutron fluence is currently being applied at several laboratories around the world. The niobium dosimeter appears to have desirable properties of providing a neutron fluence measure that corresponds to the changes in the mechanical properties of ferritic materials used in structural components of nuclear reactors and a reaction product with a suitably long half-life (T/sub 1/2/ = 16.13 +- 0.15y). Recently, an effort has been made to develop methods and procedures to routinely analyze niobium dosimeters at the Idaho National Engineering Laboratory (INEL). This effort includes the study of sample preparations, counting techniques, detector calibrations, calibration standards, data analyses and uncertainty evaluations.

8605 (KFK—3644-B) Experiments with the SUR 100 training reactor. Milicic, B. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Schule fuer Kerntechnik). Jun 1984. 106p. (In Spanish). NTIS (US Sales Only), PC A06/MF A01. File Number DE85750106.

This paper contains a compilation of various experiments using the SUR - 100 reactor for training purposes, which have been widly proved in practical work at the School for Nuclear Technology of the Karlsruhe Research Center.

8606 (LA—10230-MS) Analysis of central worths and other integral data from the Los Alamos benchmark assemblies. Muir, D.W. (Los Alamos National Lab., NM (USA)). Oct 1984. Contract W-7405-ENG-36. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85005233.

We have compared theoretical calculations, based on ENDF/B-V and recent revisions, with integral data measured on the Los Alamos unmoderated critical assemblies Godiva, Jezebel, Flattop-25, and Flattop-Pu. The experimental data included in this analysis are multiplication factors k/sub eff/ and (in most cases) both fission rates and central-worth ratios for ^{235}U, ^{238}U, ^{237}Np, and ^{239}Pu. Based on this comparison, we conclude that there is a need for a new ^{235}U evaluation, and increased accuracy is needed in certain integral measurements.

8607 (NFL—38) Progress report 1983. (Studsvik Science Research Lab., Nykoeping (Sweden)). 1984. 112p. NTIS (US Sales Only), PC A06/MF A01. File Number DE85700220.

The facilities at the Studsvik Research Centre serve as a basis for fundamental research. The neutron diffraction work aiming at determining crystal structures has continued both with single crystals and with powders in collaboration with university groups from Lund, Goeteborg, Stockholm, Umeaa and Uppsala. Facilities for work on proteins and on liqiuds will be installed. Results for a number of compounds are reported. Neutron diffraction studies are made on molecular motion in liquid metals and salts, the determination of static and dynamic scattering factors in liqiuid metals and the diffusion of hydrogen in alloys. Another field is the elementary excitations in liquid ^{3}He, and studies of nuclear spin ordering in solid ^{3}He. On-line-isotope-separator experiments (OSIRIS) has been performed using a conventional target-ion source system. The main research activity has been on decay properties, including delayed neutrons, for short-lived, very neutron rich fission products. Other aspects of fission, and also heavy-ion induced reactions are studied in collaboration with Lawrence Berkeley Laboratory and Oregon State University. Work is done on construction of a high temperature ion-source and the Van der Graff-accelerator for various experiments in neutron physics, including reference work on scattering of neutrons from carbon. The accelerator is also used for integral determinations of decay heat in nuclear fuel, for development of neutron diagnostical methods for use in fusion experiments, for study of (α,n)-processes of astrophysical im-

portance, and as an analytical tool using the PIXE technique. The radiation chemical group has continued their studies of primary reactions in crystalline materials using pulse radiolysis and ESR spectrometry techniques. The optical properties and the reactions of trapped electrons have been investigated. Recently cationic species of hydrocarbons have been studied using ESR.

8608 **(NUREG/CR—3886) Activity and fluence calculations for the startup and two-year irradiation experiments performed at the poolside facility.** Maerker, R.E.; Worley, B.A. (Oak Ridge National Lab., TN (USA)). Oct 1984. Contract AC05-84OR21400. 47p. (ORNL/TM—9265). NTIS, PC A03/MF A01 - GPO. File Number TI85001905.

Fluence rate, fluence, and activity calculations are presented for each of three exposures (two surveillance capsules and a pressure vessel capsule) performed during the two-year metallurgical blind test experiment at the ORR-Poolside Facility in Oak Ridge. This experiment is intended to serve as an international metallurgical benchmark, and the spectral fluence calculations described in this report have been made available to the international community in pressure vessel dosimetry to be used in their damage assessment studies and/or adjustment procedures. Following the same simplified calculational methods introduced and described in a reanalysis of the startup experiment, fission source distributions were obtained from 3-dimensional diffusion theory for most of the 52 cycles active during the course of the complete experiment, combined in small groups, and the resultant ex-core group fluxes calculated by two-dimensional discrete ordinate transport theory. Dosimeter activities at the end of each of the three irradiations were calculated by decaying the saturated activities obtained for each group of cycles and summing over the pertinent cycles.

2207 Plutonium And Isotope Production Reactors

8609 **(DPST—84-876) Flow measurement by Laser Doppler Anemometry in a nuclear fuel assembly.** Kehoe, A. (Georgia Inst. of Tech., Atlanta (USA). School of Mechanical Engineering). Dec 1984. Contract AC09-76SR00001. 206p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE85003260.

Development of a Laser Doppler Anemometer measurement system and its operation are examined in this research. The system is designed for flow measurement in laboratory models of nuclear fuel assemblies. Use of the system is demonstrated by measuring turbulent velocity profiles in the laboratory model at full scale reactor flow rates. The reactors at the Savanah River Plant (SRP) are heavy water moderated and operate at low temperatures and pressures. Reactor power is currently limited by the temperature of the water in the nuclear fuel assembly. These temperature limits are conservatively calculated without allowing for any turbulent mixing. This research incorporates the design, fabriction and operation of a plexiglas model fuel assembly for the purpose of making turbulent velocity measurement via a Laser Doppler Anemometer System.

2209 Reactor Safety

REFER ALSO TO CITATION(S) 2209008595, 8602

8610 **(AD-A—145567/4) Persistence differences between the Three Mile Island residents and a control group. Doctoral thesis.** Collins, D.L. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA)). May 1984. 97p. NTIS, PC A05/MF A01.

The nuclear accident at Three Mile Island (TMI) occurred on March 28, 1979. The purpose of this dissertation was to compare TMI residents to a demographically similar control group to determine (1) if the chronic stress experience by TMI residents would influence persistence on two experimental tasks, and (2) whether effects on task persistence would vary depending upon individual coping style and degree of behavioral involvement with the tasks. All subjects resided within sight of the damaged nuclear power plant at TMI. The control group subjects were from Frederick, MD located over eighty miles away. It was hypothesized that the TMI residents would exhibit significantly less persistence on the chance tasks than would the control group. It was anticipated that, in the low involvement condition, all subjects would show significantly less persistence than in the high involvement condition. The method selected to roll the dice (i.e., hand or cup) was expected to be significantly different between the TMI and Frederick groups, with more TMI subjects choosing to roll the dice by hand. Subjects with a High-Control-Oriented coping style were expected to persist longer than those subjects with a Low-Control-Oriented coping style. All these hypotheses were confirmed except one. These responses appear to be related to the TMI resident's experiences with chronic stress and other influences in their environment.

8611 **(BMI—1984-047) Fundamentals for the safety-relevant design of rotational shiftplans in nuclear power plants.** Preuss, W.; Herbert, K.W.; Reinartz, G.; Saniter, R. (Bundesministerium des Innern, Bonn (Germany, F.R.); Technischer Ueberwachungs-Verein Rheinland e.V., Koeln (Germany, F.R.). Inst. fuer Unfallforschung). Jul 1984. 183p. (In German). NTIS (US Sales Only), PC A09/MF A01. File Number DE85750104.

The investigation was concerned with the influence of rotational shiftwork on operator performance, particularly in the nuclear power industry. In an analysis of the literature, the fundamental chronobiological knowledge was reviewed. Work physiological criteria for the design of shiftplans were assembled and their relevance to this industry was assessed. In addition, interviews were held with representatives from nuclear power utilities in the Federal Republic of Germany and also in Switzerland and the Netherlands. Characteristics of the shiftplans in current use were recorded and the basic operating principles of the shift systems were ascertained. The alternative designs were discussed and assessed from the point of view of operator performance and their significance to safety. The results of the analysis of the literature and of the interviews with the utilities are presented in two separate volumes of the report.

8612 **(BNL-NUREG—30034) Carbon monoxide burning during core meltdown events in a PWR.** Jaung, R.; Bari, R.A.; Pratt, W.T. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 7p. (CONF-811103—135). NTIS, PC A02/MF A01 - GPO. File Number TI85003653.

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

This paper examines the potential for burning of mixtures of H_2-CO-air during core meltdown sequences in a typical 1000-MKWe PWR with a large, dry containment.

8613 **(BNL-NUREG—35410) Results of comparative assessment of US and Foreign Nuclear Power Plant dose experience and dose reduction programs.** Baum, J.W.; Horan, J.R.; Dionne, B.J. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 16p. (CONF-8410142—45). NTIS, PC A02/MF A01 - GPO. File Number TI85003031.

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

Based on data evaluated to date it is clear that US plants have higher collective dose equivalents per reactor and per MW-y generated than most other countries. Factors which contribute to low doses include: (1) minimization of cobalt in primary system components exposed to water, (2) careful control of primary system oxygen and pH, (3) good primary system water purity to minimize corrosion product formation, (4) careful plant design, layout and component segration and shielding, (5) management interest and commitment, (6) minimum number of workers and in-depth worker training, (7) use of special tools, and (8) plant standardization. It should be pointed out that reductions in exposure are more difficult and costly in plants already built and operating. The cost-effectiveness of dose reduction efforts at US plants should be carefully evaluated before recommendations are made concerning existing plants.

8614 **(CONF-840257—Vol.2) Proceedings of the 1984 DOE nuclear reactor and facility safety conference. Volume II.** (USDOE Assistant Secretary for Nuclear Energy, Washington, DC. Office of Nuclear Safety). 1984. Contract AC05-76OR00033. 276p. NTIS, PC A13/MF A01; GPO Dep. File Number DE84012694.

From DOE nuclear reactor and facility safety conference; Rockville, MD, USA (27 Feb 1984).

This report is a collection of papers on reactor safety. The report takes the form of proceedings from the 1984 DOE Nuclear Reactor and Facility Safety Conference, Volume II of two. These proceedings cover Safety, Accidents, Training, Task/Job Analysis, Robotics and the Engineering Aspects of Man/Safety interfaces.

8615 **(DOE/EV/10599—T1) Fire protection program evaluation of Argonne National Laboratory, West for the Department of Energy.** (Professional Loss Control, Inc., Oak Ridge, TN (USA)). 22 Oct 1984. Contract AC01-81EV10599. 58p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85004564.

A fire protection engineering survey was conducted of the Argonne National Laboratory, West Facility, near Idaho Falls, Idaho. This facility includes EBR-II, TREAT, ZPPR, and HFEF. The facility meets the improved risk criteria as set forth in DOE Order 5480.1, Chapter VII. Some recommendations are given.

8616 **(EGG-M—03584) Thermal-hydraulic and core damage analysis of the station blackout transient in pressurized water reactors.** Dobbe, C.A.; Chambers, R.; Bayless, P.D. (EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 10p. (CONF-840914—18). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003426.

From International meeting on thermal nuclear reactor safety; Karlsruhe, F.R. Germany (10 Sep 1984).

Analyses of a PWR station blackout transient performed by EG and G Idaho in support of the US Nuclear Regulatory Commission's Severe Accident Sequence Analysis (SASA) Program are presented. The RELAP5 and SCDAP computer codes were used to calculate the effects of concurrent loss of off-site power, on-site power, and emergency feedwater on the Babcock and Wilcox (B and W) designed Bellefonte PWR and the Westinghouse designed Seabrook PWR. Results provide insight into the timing of significant events, severity of core damage, and effect of differences between the two PWR designs on transient results.

8617 **(EGG-M—03684) RELAP5 thermal-hydraulic analyses of overcooling sequences in a pressurized water reactor.** Bolander, M.A.; Fletcher, C.D.; Davis, C.B.; Kullberg, C.M.; Stitt, B.D.; Waterman, M.E.; Burtt, J.D. (Idaho National Engineering Lab., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 9p. (CONF-840914—21). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003425.

From International meeting on thermal nuclear reactor safety; Karlsruhe, F.R. Germany (10 Sep 1984).

In support of the Pressurized Thermal Shock Integration Study, sponsored by the United States Nuclear Regulatory Commission, the Idaho National Engineering Laboratory has performed analyses of overcooling transients using the RELAP5/MOD1.6 and MOD2.0 computer codes. These analyses were performed for the H.B. Robinson Unit 2 pressurized water reactor, which is a Westinghouse 3-loop design plant. Results of the RELAP5 analyses are presented. The capabilities of the RELAP5 computer code as a tool for analyzing integral plant transients requiring a detailed plant model, including complex trip logic and major control systems, are examined.

8618 **(EGG-M—04084) Comparison of RELAP5/MOD1.6, TRAC-BD1/Version 12, and TRAC-BD1/MOD1 assessments with data from a ROSA III small break test.** Wagner, K.C.; Dallman, R.J. (EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 11p. (CONF-840914—24). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003430.

From International meeting on thermal nuclear reactor safety; Karlsruhe, F.R. Germany (10 Sep 1984).

A comparative analysis of three assessment studies of Run 912 from the ROSA-III small break LOCA test series has been performed. Two of the studies were done using the TRAC-BD1 computer code, while the RELAP5 code was used for the third study. The studies are part of INEL's support to the United States Nuclear Regulatory Commission for the independent assessment of reactor safety codes. The ability of each computer code to calculate pertinent thermal-hydraulic phenomena in the experiment is presented. The run time assessment statistics are also presented.

8619 **(EGG-M—04884) Influence of zircaloy oxidation and melting behavior on core behavior during a severe accident.** Allison, C.M.; Hagrman, D.L.; Berna, G.A. (EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 11p. (CONF-840914—27). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003432.

From International meeting on thermal nuclear reactor safety; Karlsruhe, F.R. Germany (10 Sep 1984).

The influence of zircaloy oxidation and melting on core temperatures, hydrogen generation, and fission product release is examined. The uncertainties in phenomena important to the modeling of zircaloy oxidation and melting processes including zircaloy oxidation kinetics, hydrogen blanketing, UO_2-zircaloy interactions, and ZrO_2 failure are estimated. These uncertainties are then applied to a sensitivity study of a boiloff-initiated severe accident similar to that which may have occurred in TMI-2. Results indicate that the major uncertainties are in the oxidation kinetics which can contribute a factor of ten to the uncertainties in fission product release and can affect the timing of that release.

8620 **(EGG-M—04984) SCDAP code analysis of the Power Burst Facility Severe Fuel Damage Test 1-1.** Siefken, L.J. (EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 9p. (CONF-840914—20). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003434.

From International meeting on thermal nuclear reactor safety; Karlsruhe, F.R. Germany (10 Sep 1984).

The SCDAP code models the processes taking place in a reactor fuel bundle during a severe reactor accident. This paper assesses the models in the code using the results of the PBF test SFD 1-1. Calculated and measured test bundle temperatures, hydrogen production, meltdown, and fission gas release are compared and found to be in good agreement. Calculations indicate that oxidation in the bundle proceeds at a rate proportional to the steam flow rate from coolant boil-off. The oxidation is confined to a moving axial region about 10 cm in height. Runaway oxidation is terminated by the flowing away of liquefied cladding. Most of the fission product release from the bundle fuel is calculated to be due to fuel dissolution.

8621 **(EGG-M—05184) Severe Fuel Damage Test 1-1 results.** MacDonald, P.E.; Nalezny, C.L.; McCardell, R.K. (EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 12p. (CONF-840914—26). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003433.

From International meeting on thermal nuclear reactor safety; Karlsruhe, F.R. Germany (10 Sep 1984).

A series of severe fuel damage tests is being performed in the Power Burst Facility to obtain data necessary to understand (a) fuel behavior and coolability; (b) fission product release, deposition, and transport; and (c) hydrogen release during degraded core cooling accidents. This report presents the preliminary results of the second experiment of the Severe Fuel Damage (SFD) series, Test SFD 1-1. The measurements indicate that the test conditions required to simulate the fuel damage and fission produce release in a 3000-MW(t) commercial pressurized water reactor core during a small break loss-of-coolant accident without emergency core coolant injection were successfully achieved. Such an accident is characterized by an initial slow heating rate to about 1600°K, followed by a very rapid heating rate driven by runaway metal-water reaction that is steam limited in the upper regions of the core. The fast heatup achieved during the SFD 1-1 test resulted in oxidation of about 30% of the cladding and shroud inner liner and melting of much of the cladding in the lower regions of the fuel bundle. Significant liquefaction of the UO_2 fuel occurred and molten cladding and liquefied fuel slumped to lower bundle elevations. The fission

product release during this test was less than during the first experiment of the series (the Scoping Test, which was performed at relatively high steam flow rates), during which nearly all of the cladding was oxidized. Iodine and cesium followed the liquid pathway, and most of the tellurium remained within the test bundle.

8622 **(EGG-M—05284) Behavior of fission products released from severely damaged fuel during the PBF severe fuel damage tests.** Osetek, D.J.; Cronenberg, A.W.; Hagrman, D.L.; Broughton, J.M.; Rest, J. (EG and G Idaho, Inc., Idaho Falls (USA); Engineering Science and Analysis, Idaho Falls, ID (USA); Argonne National Lab., IL (USA)). 1984. Contract AC07-76ID01570. 25p. (CONF-840914—25). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003428.

From International meeting on thermal nuclear reactor safety; Karlsruhe, F.R. Germany (10 Sep 1984).

The results of fission product release behavior during the first two Power Burst Facility Severe Fuel Damage tests are presented. Measured fission product release is compared with calculated release using temperature dependent release rate correlations and FASTGRASS analysis. The test results indicate that release from fuel of the high volatility fission products (Xe, Kr, I, Cs, and Te) is strongly influenced by parameters other than fuel temperature; namely fuel/fission product morphology, fuel and cladding oxidation state, extent of fuel liquefaction, and quench induced fuel shattering. Fission product transport from the test fuel through the sample system was strongly influenced by chemical effects. Holdup of I and Cs was affected by fission product chemistry, and transport time while Te release was primarily influenced by the extent of zircaloy oxidation. Analysis demonstrates that such integral test data can be used to confirm physical, chemical, and mechanistic models of fission product behavior for severe accident conditions.

8623 **(EGG-M—05384) Tellurium behavior during and after the TMI-2 accident.** Vinjamuri, K.; Osetek, D.J.; Hobbins, R.R. (EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 20p. (CONF-840914—22). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003429.

From International meeting on thermal nuclear reactor safety; Karlsruhe, F.R. Germany (10 Sep 1984).

The estimated behavior of tellurium during and after the accident at the Three Mile Island Unit-2 is presented. The behavior is based on all available measurement data for /sup 129m/Te, ^{132}Te and stable tellurium (^{128}Te, ^{123}Te and ^{130}Te), and best estimate calculations of tellurium release and transport. The predicted release was calculated using current techniques that relate release rate to fuel temperature and holdup of tellurium in zircaloy until significant oxidation occurs. The calculated release fraction was low, approximately 7%, but the total measured release for samples analyzed to date is about 4.0%. Of the measured tellurium about 2.4, 0.88, 0.42, 0.17 and 0.086% of core inventory were in the containment sump water, containment solids in water, makeup and purification demineralizer, containment inside surface, and the reactor primary coolant, respectively. A significant fraction (54%) of the calculated tellurium retained on the upper plenum surfaces (4.61% of the core inventory) was deposited during the high pressure injection of coolant at about 200 minutes after the reactor scram. Comparison of tellurium behavior with inpile and out-of-pile tests strongly suggests that zircaloy holds tellurium until significant cladding oxidation occurs.

8624 **(EGG-M—05484) Analysis of recovery procedures for a single steam generator tube rupture.** Nalezny, C.L.; Chen, T.H. (EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 10p. (CONF-840914—19). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003435.

From International meeting on thermal nuclear reactor safety; Karlsruhe, F.R. Germany (10 Sep 1984).

The LOFT Experiments L6-8C-1 and L6-8C-2 simulated a single steam generator tube rupture, a transient that is likely to occur during the lifetime of a commercial pressurized water reactor (PWR). These experiments were designed to evaluate an alternative procedure for recovery from such an accident, and to evaluate techniques used to analyze reactor transients. Experiment L6-8C-1 was the alternative procedure, conducted with the reactor coolant pumps on while depressurizing the primary coolant system by feed and bleed of the unaffected steam generator, and operation of the pressurizer spray. Experiment L6-8C-2 simulated the standard procedure used in commercial PWRs and was conducted with the reactor coolant system by feed and bleed of the unaffected steam generator, and operation of the power-operated relief valve. The results of the study indicate that the pressurizer spray is as effective as the power operated relief valve. The results of the study indicate that the pressurizer spray is as effective as the power operated relief valve for reducing the primary system pressure, and can be used to reduce the release of primary system coolant to the environment. The results of the posttest calculations agreed very well with the data, and indicated that the RELAP5/MOD1 code could be a capable analytical tool for studying reactor safety problems.

8625 **(EGG-M—08884) Boiling water reactor containment modeling and analysis at the Idaho National Engineering Laboratory.** Holcomb, E.E. III; Wilson, G.E. (Idaho National Engineering Lab., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 14p. (CONF-841075—8). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003418.

From International thermal hydraulics and plant operations topical meeting; Taipei, Taiwan (22 Oct 1984).

Under the auspices of the United States Nuclear Regulatory Commission, severe accidents are being studied at the Idaho National Engineering Laboratory. The boiling water reactor (BWR) studies have focused on postulated anticipated transients without scram (ATWS) accidents which might contribute to severe core damage or containment failure. A summary of the containment studies is presented in the context of the analytical tools (codes) used, typical transient simulation results and the need for prototypical containment data. All of these are related to current and future analytical capabilities. It is shown that torus temperatures during the ATWS depart from limiting conditions for BWR T-quencher operation, outside of which stable steam condensation has not been proven.

8626 **(EGG-M—10384) Application of TRAC-BD1/MOD1 to a BWR/4 feedwater control failure ATWS.** Rouhani, S.Z.; Giles, M.M.; Mohr, C.M. Jr.; Weaver, W.L. III. (EG and G Idaho, Inc., Idaho Falls (USA); Giles (Monte M.), Hamilton, MT (USA)). 1984. Contract AC07-76ID01570. 7p. (CONF-841075—9). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003419.

From International thermal hydraulics and plant operations topical meeting; Taipei, Taiwan (22 Oct 1984).

This paper begins with a short description of the Transient Reactor Analysis Code for Boiling Water Reactors (TRAC-BWR), briefly mentioning some of its main features such as specific BWR models and input structure. Next, an input model of a BWR/4 is described, and, the assumptions used in performing an analysis of the loss of a feedwater controller without scram are listed. The important features of the calculated trends in flows, pressure, reactivity, and power are shown graphically and commented in the text. A comparison of some of the main predicted trends with the calculated results from a similar study by General Electric is also presented.

8627 **(EGG-M—12284) RELAP5/MOD2 overview and developmental assessment results from TMI-1 plant transient analysis.** Lin, J.C.; Tsai, C.C.; Ransom, V.H.; Johnsen, G.W. (EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 8p. (CONF-841075—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003549.

From International thermal hydraulics and plant operations topical meeting; Taipei, Taiwan (22 Oct 1984).

RELAP5/MOD2 is a new version of the RELAP5 thermal-hydraulic computer code containing improved modeling features that provide a generic capability for pressurized water reactor transient simulation. Objective of this paper is to provide code users with an overview of the code and to report developmental assessment results obtained from a Three Mile Island Unit One plant transient analysis. The assessment shows that the injection of highly subcooled water into a high-pressure primary coolant system does

not cause unphysical results or pose a problem for RELAP5/MOD2.

8628 **(EGG-M—16184) Nuclear plant analyzer development and analysis applications.** Laats, E.T. (EG and G Idaho, Inc., Idaho Falls (USA)). Oct 1984. Contract AC07-76ID01570. 8p. (CONF-841075—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003548.

From International thermal hydraulics and plant operations topical meeting; Taipei, Taiwan (22 Oct 1984).

The Nuclear Plant Analyzer (NPA) is being developed as the US Nuclear Regulatory Commission's (NRC's) state of the art safety analysis and engineering tool to address key nuclear plant safety issues. This paper describes four applications of the NPA in assisting reactor safety analyses. Two analyses evaluated reactor operating procedures, during off-normal operation, for a pressurized water reactor (PWR) and a boiling water reactor (BWR), respectively. The third analysis was performed in support of a reactor safety experiment conducted in the Semiscale facility. The final application demonstrated the usefulness of atmospheric dispersion computer codes for site emergency planning purposes. An overview of the NPA and how it supported these analyses are the topics of this paper.

8629 **(EGG-M—16884) Posttest data analysis and assessment of TRAC-BD1/MOD1 with data from a Full Integral Simulation Test (FIST) power transient experiment.** Wheatley, P.D.; Wagner, K.C. (Idaho National Engineering Lab., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 10p. (CONF-840914—23). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003431.

From International meeting on thermal nuclear reactor safety; Karlsruhe, F.R. Germany (10 Sep 1984).

The FIST power transient test 6PMC2 was analyzed to further the understanding of the FIST facility and provide an assessment of TRAC-BD1/MOD1. FIST power transient 6PMC2 investigated the thermal-hydraulic response following inadvertent closure of the main steam isolation valve and the subsequent failure of the reactor to scram. Failure of the high pressure core spray system was also assumed, resulting on only the reactor core isolation cooling flow for inventory makeup during the transient. The experiment was a sensitivity study with relatively high core power and low makeup rates. This study provides one of the first opportunities to assess TRAC-BD1/MOD1 under power transient and natural circulation conditions with data from a facility with prototypical BWR geometry. The power transient test was analyzed with emphasis on the following phenomena; (a) the system pressure response, (b) the natural circulation flows and rates, and (c) the heater rod cladding temperature response. Based on the results of this study, TRAC-BD1/MOD1 can be expected to calculate the thermal-hydraulic behavior of a BWR during a power transient.

8630 **(EGG-M—18384) PWR station blackout accident results for the Bellefonte and Seabrook plants.** Bayless, P.D.; Chambers, R.; Dobbe, C.A. (EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 8p. (CONF-8410142—63). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003589.

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

The analyses have shown that the Bellefonte and Seabrook plants responded similarly to the TMLB station blackout sequence. Although the significant events that occurred were the same, the timing was different. The transient occurred much faster in Bellefonte than in Seabrook because of the smaller initial liquid inventory on the secondary side of the steam generators. The core damage was similar in both plants. The amount of cladding oxidized was 4% in both cases. The amounts of fission products released to the coolant and of core material relocated were nearly identical for the two plants at any given temperature. The main difference in the core damage was the extent of the ballooning. The lower heatup rate and higher temperatures in the Seabrook calculation resulted in more extensive ballooning than in the Bellefonte calculation. The presence of vent valves in the reactor vessel had no noticeable effect on the transient response in the RELAP5 calculations.

8631 **(EGG-M—18684) RELAP5/MOD2 blind calculation of GERDA small break test and data comparison.** Ogden, D.M.; Steiner, J.L. (EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 24p. (CONF-8410142—62). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003410.

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

The RELAP5/MOD2 calculation predicted the major features of the test reasonably well. This included the natural circulation flow and its interruption due to loop voiding which degraded the driving potential. The boiler condenser mode of heat transfer was well predicted although the timing of its initiation was not well predicted. In both the experiment and calculation, the BCM was initiated when the primary side steam generator level dropped below the secondary level, creating the potential to condense the steam. The BCM was interrupted when the primary level recovered above the secondary level. The system refill after the period of BCM heat transfer was reasonably well predicted. The refill resulted in a restart of the natural circulation flow as the driving potential was reestablished. Major differences in refill were attributed to differences in boundary conditions (HPI flow and core power) and the modeling of system heat loss, particularly from the upper head and the hot leg.

8632 **(EGG-M—18884) Posttest data analysis of FIST experimental TRAC-BD1/MOD1 power transient experiment.** Wheatley, P.D.; Wagner, K.C. (Idaho National Engineering Lab., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 15p. (CONF-8410142—46). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003592.

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

The FIST power transient test 6PMC2 was analyzed to further the understanding of the FIST facility and provide an assessment of TRAC-BD1/MOD1. FIST power transient 6PMC2 investigated the thermal-hydraulic response following inadvertent closure of the main steam isolation valve and the subsequent failure of the reactor to scram. Failure of the high pressure core spray system was also assumed, resulting in only the reactor core isolation cooling flow for inventory makeup during the transient. The experiment was a sensitivity study with relatively high core power and low makeup rates. This study provides one of the first opportunities to assess TRAC-BD1/MOD1 under power transient and natural circulation conditions with data from a facility with prototypical BWR geometry. The power transient test was analyzed with emphasis on the following phenomena: (a) the system pressure response, (b) the natural circulation flows and rates, and (c) the heater rod cladding temperature response. Based on the results of this study, TRAC-BD1/MOD1 can be expected to calculate the thermal-hydraulic behavior of a BWR during a power transient.

8633 **(EGG-M—18984) Large break analysis of a BWR/6-218 using TRAC-BD1/MOD1, a best estimate code coupled with evaluation model type boundary conditions.** Wheatley, P.D. (Idaho National Engineering Lab., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 21p. (CONF-8410142—55). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003593.

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

An analysis of a boiling water reactor (BWR)/6 was conducted at Idaho National Engineering Laboratory (INEL). The analysis used the Transient Reactor Analysis Code (TRAC) BWR version (TRAC-BD1/MOD1) to calculate a design basis, large break loss-of-coolant accident with evaluation model type boundary conditions. This analysis is a part of a Nuclear Regulatory Commission (NRC) study of plant safety margin. Results of the analysis are presented showing a large margin between the calculated peak cladding temperature and the Appendix K limits.

8634 **(EGG-M—19084) Independent assessment of the TRAC-BD1/MOD1 computer code at the Idaho National Engineering Laboratory.** Wilson, G.E.; Charboneau, B.L.; Dallman, R.J.; Kullberg, C.M.; Wagner, K.C.; Wheatley, P.D. (Idaho National Engineering Lab., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 14p. (CONF-8410142—47). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003595.

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

Under auspices of the United States Nuclear Regulatory Commission, their primary boiling water reactor safety analysis code (TRAC-BWR) is being assessed with simulations of a wide range of experimental data. The FY-1984 assessment activities were associated with the latest version (TRAC-BD1/MOD1) of this code. Typical results of the assessment studies are given. Conclusions formulated from these results are presented. These calculations relate to the overall applicability of the current code to safety analysis, and to future work which would further enhance the code's quality and ease of use.

8635 **(EGG-M—19884) Status of RELAP5/MOD2 development and assessment.** Johnsen, G.W. (EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 15p. (CONF-8410142—48). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003551.

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

Improvements and refinements made to the RELAP5/MOD2 computer code are described and illustrated. Modifications made to the code since a general release of the first version in April involve vertical phase separation modeling, a water-packing mitigation scheme, a more implicit numerical solution scheme, enhanced code portability, and user conveniences.

8636 **(EGG-M—20084) Experimental evaluation of an expert system for nuclear reactor operators.** Nelson, W.R. (EG and G Idaho, Inc., Idaho Falls (USA)). Oct 1984. Contract AC07-76ID01570. 7p. (CONF-8410161—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003557.

From 18. European symposium on calcified tissue; Angers, France (11 Oct 1984).

The United States Nuclear Regulatory Commission (USNRC) is supporting a program for the experimental evaluation of an expert system for nuclear reactor operators. A prototype expert system, called the Response Tree System, has been developed and implemented at INEL. The Response Tree System is designed to assess the status of a reactor system following an accident and recommend corrective actions to reactor operators. The system is implemented using color graphic displays and is driven by a computer simulation of the reactor system. Control of the system is accomplished using a transparent touch panel. Controlled experiments are being conducted to measure performance differences between operators using the Response Tree System and those not using it to respond to simulated accident situations. This paper summarizes the methodology and results of the evaluation of the Response Tree System, including the quantitative results obtained in the experiments thus far. Design features of the Response Tree System are discussed, and general conclusions regarding the applicability of expert systems in reactor control rooms are presented.

8637 **(EGG-M—23684) Recommended radiological air sampling and internal contamination control at nuclear power plants.** Rich, B.L.; Ritter, P.D.; Martz, D.E. (EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 9p. (CONF-8410142—42). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003556.

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

It has long been recognized by the NRC Technical Staffs that estimating the quantity of radioactivity inhaled by an individual worker involved large uncertainties. General air samples usually produce concentrations lower than those in the workers Breathing Zone (BZ). NRC guides have recognized this problem by specifying air monitoring programs which sample the Breathing Zone or concentrations known to be higher than that actually inhaled. In addition the availability of suitable samplers to obtain BZ samples and the practicality of requiring their use was somewhat in question to the NRC technical staff. AN NRC development contract was issued to provide a detailed review of the technical aspects of the problems and recommendations for practical upgrade of federal guidance. This project accomplished a review of the nuclear industry experience and knowledge through a literature search, site visits to representative licensed facilities, telephone surveys of many others, laboratory testing of personal air samplers (lapel samplers) and aerosol diffusion experiments to verify key conclusions and assumptions.

8638 **(EGG-M—23784) Pipe damping.** Ware, A.G.; Arendts, J.G. (EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 11p. (CONF-8410142—57). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003412.

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

A program has been developed to assess the available piping damping data, to generate additional data and conduct seperate effects tests, and to establish a plan for reporting and storing future test results into a data bank. This effort is providing some of the basis for developing higher allowable damping values for piping seismic analyses, which will potentially permit removal of a considerable number of piping supports, particularly snubbers. This in turn will lead to more flexible piping systems which will be less susceptible to thermal cracking, will be easier to maintain and inspect, as well as less costly.

8639 **(EGG-M—24184) Environmental/dynamic mechanical equipment qualification and dynamic electrical equipment qualification program (EDQP).** Hunter, J.A. (Idaho National Engineering Lab., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 14p. (CONF-8410142—59). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003559.

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

Equipment qualification research is being conducted to investigate acceptable criteria, requirements, and methodologies for the dynamic (including seismic) and environmental qualification of mechanical equipment and for the dynamic (including seismic) qualification of electrical equipment. The program is organized into three elements: (1) General Research, (2) Environmental Research, and (3) Dynamic Research. This paper presents the highlights of the results to date in these three elements of the program.

8640 **(EPRI-NP—3752-SR) Calvert Cliffs 1 reactor vessel: pressurized thermal shock analysis for a small steam line break.** Chexal, B.; Marston, T.; Griesbach, T.; Chao, J.; Norris, D.; Layman, B. (Electric Power Research Inst., Palo Alto, CA (USA)). Nov 1984. 85p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $11.50. File Number TI85920140.

A best-estimate vessel integrity analysis was performed for a hypothetical six-inch-diameter steam line break accident in Calvert Cliffs Unit 1, a Combustion Engineering PWR. The analysis was made using the linked set of codes developed by EPRI for performing pressurized thermal shock analysis. This effort was in support of EPRI's reactor vessel pressurized thermal shock program.

8641 **(GEND—043) TMI-2 pyrophoricity studies.** Baston, V.F.; Austin, W.E.; Hoffstetter, K.J.; Owen, D.E. (EG and G Idaho, Inc., Idaho Falls (USA)). Nov 1984. Contract AC07-76ID01570. 35p. NTIS, PC E03/MF A01; GPO Dep. File Number DE85003777.

Includes 1 sheet of 24x reduction microfiche.

This report summarizes an extensive literature review and experimental evaluation of the pyrophoric potential of debris and material from within the TMI-2 reactor system. The literature on pyrophoricity recommends educated caution during handling of the TMI-2 core debris because of the presence of zirconium, zirconium alloys, and the potential for some oxidizable zirconium compounds. Laboratory testing of zirconium-bearing TMI-2 core debris specimens obtained from locations within the reactor vessel show no pyrophoric potential. These data support TMI-2 accident analyses that have concluded that most of the zirconium particulates in the

core were oxidized by the high temperature steam environment during the accident. In addition, the presence of other constituents in the core debris effectively dilutes any oxidizable zirconium, thereby rendering sustained propagation of any pyrophoric events unlikely. Consequently, a reactor defueling scheme has been developed for TMI-2 which acknowledges that, while complete understanding of the zirconium oxidation state is impossible, the safe handling techniques to be used during defueling minimize the concern for any pyrophoric event.

8642 **(Juel—1908) Numerical simulation of the facility behaviour of a high temperature reactor under water ingress accidents at the example of the AVR.** Wawrzik, U. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung; Technische Hochschule Aachen (Germany, F.R.)). Mar 1984. 124p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE85750101.

Detailed analysis of massive water ingress accidents in high temperature reactors supposes a numerical simulation of the whole facility behaviour. For the AVR-reactor such a model was developed to describe both the graphite corrosion processes and the accident transients for different releasing events as well as resulting accident profiles. The variable consideration of regulating facilities of the safety circuit being influenced in reality, enables an optimization of the accident profiles in the way of a least possible facility damage. It results that in spite of extremely conservative input data with authorization legal relevance even the possible water ingress accidents can safely be controlled after 15 years of operation with steadily increasing safety requirements. First investigations on a selected facility concept for the AVR-reequipment show, that with the definition up to now of the AVR-steam generator failure the accident profiles "reactor under pressure" are conservatively coped with. An increasing degree of detail of the concept proposals, however, requires an examination of this statement.

8643 **(KFK—3509) Temperature escalation in PWR fuel rod simulator bundles due to the Zircaloy/steam reaction: Test ESBU-2A.** Hagen, S.; Kapulla, H.; Malauschek, H.; Wallenfels, K.P.; Peck, S.O. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Ingenieurtechnik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Nukleare Sicherheit). Jul 1984. 70p. NTIS (US Sales Only), PC A04/MF A01. File Number TI85750473.

This report describes the test conduct and results of the bundle test ESBU-2A, which was run to investigate the temperature escalation of Zircaloy clad fuel rods. This investigation of temperature escalation is part of a series of out-of-pile experiments, performed within the framework of the PNS Severe Fuel Damage Program. The test bundle was of a 3 x 3 array of fuel rod simulators with a 0.4 m heated length. The fuel rod simulators were electrically heated and consisted of tungsten heaters, UO_2 annular pellets, and Zircaloy cladding. A nominal steam flow of 0.7 g/s was inlet to the bundle. The bundle was surrounded by a Zircaloy shroud which was insulated with ZrO_2 fiber ceramic wrap. The initial heatup rate of the bundle was 0.4°C/s. The temperature escalation began at the 255 mm elevation after 1200°C had been reached. At this elevation, the measured peak temperature was limited to 1500°C. It was concluded from different thermocouple results, that induced by this first escalation melt was formed in the lower part of the bundle. Consequently, the escalation in the lower part must be much higher, at least up to the melting temperature of Zircaloy. Due to the failure in the steam production system, steam starvation in the upper region may explain the beginning of the escalation at the 255 mm elevation. The maximum temperature reached was 2175°C on the center rod at the end of the test. The unregularities in the steam supply may be the reason for less oxidation than expected.

8644 **(KFK—3753) Modeling steady state and transient fission gas behaviour with the Karlsruhe code LAKU.** Vaeth, L. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). Aug 1984. 85p. NTIS (US Sales Only), PC A05/MF A01. File Number TI85750477.

The programme LAKU models the behaviour of gaseous fission products in reactor fuel under steady state and transient conditions, including molten fuel. A presentation of the full model is given, starting with gas behaviour in the grains and on grain faces and including the treatment of release from porosity. The results of some recent calculations are presented.

8645 **(NUREG/CP—0053) Proceedings of the ninth annual statistics symposium on national energy issues.** Bryson, M.C. (comp.). (Los Alamos National Lab., NM (USA)). Jun 1984. Contract W-7405-ENG-36. 197p. (CONF-8310248—; LA—10127-C). NTIS, PC A09/MF A01 - GPO. File Number TI84016166.

From 9. annual statistics symposium on national energy issues; Rockville, MD, USA (19 Oct 1983).

The Ninth Annual Statistics Symposium on National Energy Issues was held in Rockville, Maryland, at the Holiday Inn Crowne Plaza, October 19-21, under the joint sponsorship of Los Alamos National Laboratory and the Nuclear Regulatory Commission. Sessions included two contributed-paper sessions, two tutorial sessions, and one discussion group. Included in these proceedings are those papers for which final copy was provided by the authors, together with a list of papers presented and a list of attendees.

8646 **(NUREG/CP—0056) Proceedings of the second workshop on containment integrity.** Molina, T.; Cochrell, R. (eds.). (Sandia National Labs., Albuquerque, NM (USA)). Aug 1984. Contract AC04-76DP00789. 655p. (CONF-8406124—; SAND—84-1514). NTIS, PC A99/MF A01 - GPO. File Number TI85002504.

From 2. workshop on containment integrity; Crystal City, VA, USA (13 Jun 1984).

The Second Workshop on Containment Integrity was held in Crystal City, Virginia on June 13-15, 1984. The workshop provided a forum for exchanging information on the integrity of containments at nuclear power plants. The behavior of containments during severe accidents was of primary interest to the over 130 participants. Forty-three oral presentations were made at the workshop. Written contributions that correspond to each of the presentations make up the body of this report. The workshop was hosted by Sandia National Laboratories under the sponsorship of the US Nuclear Regulatory Commission. Principal organizers for the workshop were T.E. Blejwas and W.A. von Riesmann of Sandia, T.D. Molina of Technadyne, and J.F. Costello of the US Nuclear Regulatory Commission.

8647 **(NUREG/CR—3440) Identification of severe accident uncertainties.** Rivard, J.B.; Behr, V.L.; Easterling, R.G.; Griesmeyer, J.M.; Haskin, F.E.; Hatch, S.W.; Kolaczkowski, A.M.; Lipinski, R.J.; Sherman, M.P.; Taig, A.R. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1984. Contract AC04-76DP00789. 289p. (SAND—83-1689). NTIS, PC A13/MF A01 - GPO. File Number TI85005161.

Understanding of severe accidents in light-water reactors is currently beset with uncertainty. Because the uncertainties that are present limit the capability to analyze the progression and possible consequences of such accidents, they restrict the technical basis for regulatory actions by the US Nuclear Regulatory Commission (NRC). It is thus necessary to attempt to identify the sources and quantify the influence of these uncertainties. As a part of ongoing NRC severe-accident programs at Sandia National Laboratories, a working group was formed to pool relevant knowledge and experience in assessing the uncertainties attending present (1983) knowledge of severe accidents. This initial report of the Severe Accident Uncertainty Analysis (SAUNA) working group has as its main goal the identification of a consolidated list of uncertainties that affect in-plant processes and systems. Many uncertainties have been identified. A set of key uncertainties summarizes many of the identified uncertainties. Quantification of the influence of these uncertainties, a necessary second step, is not attempted in the present report, although attempts are made qualitatively to demonstrate the relevance of the identified uncertainties.

8648 (NUREG/CR—3591-Vol.2) Precursors to potential severe core damage accidents, 1980-1981. Volume 2. Cottrell, W.B.; Minarick, J.W.; Austin, P.N.; Hagen, E.W.; Harris, J.D. (Oak Ridge National Lab., TN (USA)). Feb 1984. Contract AC05-84OR21400. 265p. (ORNL/NSIC—217/V2). NTIS, PC A12/MF A01 - GPO; GPO Dep. File Number TI84013526.

Fifty-eight PWR and BWR events for the years 1980 and 1981 were selected as precursors to potential severe core damage, based on the selection methods and criteria described in Volume 1 of this report. These precursors are documented herein. For each precursor, four items are included: a precursor description and data sheet; an actual-occurrence event tree; a sequence-of-interest event tree; and a categorization of accident sequence precursors sheet.

8649 (NUREG/CR—3784) Light Water Reactor Safety Research Program. Semiannual report, April-September 1983. Berman, M. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1984. Contract AC04-76DP00789. 250p. (SAND—84-0689). NTIS, PC A11/MF A01 - GPO. File Number TI85004287.

The Molten Fuel/Concrete Interactions (MFCI) Study investigates the mechanism of concrete erosion by molten core materials, the nature and rate of generation of evolved gases, and the effects of fission-product release. The Core Melt/Coolant Interactions (CMCI) Study investigates the characteristics of explosive and nonexplosive interactions between molten core materials and concrete, and the probabilities and consequences of such interactions. In the Hydrogen Program, the HECTR code for modelling hydrogen deflagration is being developed, experiments (including those in the FITS facility) are being conducted, and the Grand Gulf Hydrogen Igniter System II is being reviewed. All activities are continuing.

8650 (NUREG/CR—3885-Vol.1) High-Temperature Gas-Cooled Reactor safety studies for the Division of Accident Evaluation. Quarterly progress report, January 1-March 31, 1984. Volume 1. Ball, S.J.; Cleveland, J.C.; Harrington, R.M.; Siman-Tov, I.; Wilson, J.H. (Oak Ridge National Lab., TN (USA)). Aug 1984. Contract AC05-84OR21400. 21p. (ORNL/TM—9267/V1). NTIS, PC A02/MF A01 - GPO. File Number TI84017057.

Modeling and code development work for predicting source terms for the Fort St. Vrain and 2240-MW(t) reactors continued and investigations and modeling work for small modular High-Temperature Gas-Cooled Reactor designs were begun. Fission-product transport experiments to determine coefficients for diffusion through graphite have included studies with Ag, Rh, and Pd. The review of an FSV technical specification on limiting maximum core temperature involved code development and FSV data analysis, leading to new proposed limiting conditions and validation tests.

8651 (NUREG/CR—3976) Regulatory analyses for severe accident issues: an example. Burke, R.P.; Strip, D.R.; Aldrich, D.C. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1984. Contract AC04-76DP00789. 125p. (SAND—84-1727). NTIS, PC A06/MF A01 - GPO. File Number TI85003897.

This report presents the results of an effort to develop a regulatory analysis methodology and presentation format to provide information for regulatory decision-making related to severe accident issues. Insights and conclusions gained from an example analysis are presented. The example analysis draws upon information generated in several previous and current NRC research programs (the Severe Accident Risk Reduction Program (SARRP), Accident Sequence Evaluation Program (ASEP), Value-Impact Handbook, Economic Risk Analyses, and studies of Vented Containment Systems and Alternative Decay Heat Removal Systems) to perform preliminary value-impact analyses on the installation of either a vented containment system or an alternative decay heat removal system at the Peach Bottom No. 2 plant. The results presented in this report are first-cut estimates, and are presented only for illustrative purposes in the context of this document. This study should serve to focus discussion on issues relating to the type of information, the appropriate level of detail, and the presentation format which would make a regulatory analysis most useful in the decisionmaking process.

8652 (ORAU/IEA—84-3(M)) Assessment of light water reactor safety since the Three Mile Island accident. Phung, D.L. (Oak Ridge Associated Universities, Inc., TN (USA)). Nov 1984. Contract AC05-76OR00033. 220p. NTIS, PC A10/MF A01; GPO Dep. File Number DE85004240.

The NRC has completed 70% (as of 1983) of the TMI Action Plan, which is the combination of the Kemeny, Rogovin, and other recommendations. The industry has combined forces to achieve increased communication, high-quality and uniform operation, and better management of nuclear power. The state of the art of reactor safety was assessed by examining probabilistic risk assessments (PRAs) of about two dozen reactors and by studying experiments designed to answer basic safety questions. Particular attention was paid to evidences for a reduced source term, higher containment margin, and lower probabilities for breaching the containment through steam explosion or hydrogen burn. Data from PRAs and from the study of core-melt accident precursors were used in conjunction with simplified event trees to assess the safety of light water reactors (LWRs). We found that LWRs before TMI were more prone to accidents, perhaps by a factor of two than the results of WASH-1400, but thanks to actions taken since TMI, the frequency of accidents may have been reduced by a factor of two to three below that of WASH-1400. Net result is that LWRs today may be three to six times safer than reactors before TMI.

8653 (ORAU/IEA—84-7(M)) HTGR: an assessment of safety and investment risk. Fisher, C.; Fortescue, P.; Goodjohn, A.J.; Olsen, B.E.; Silady, F.A. (Oak Ridge Associated Universities, Inc., TN (USA); GA Technologies, Inc., San Diego, CA (USA)). Nov 1984. Contract AC05-76OR00033. 95p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85005143.

Improvements in the present LWR designs which do not change the basic features that raise safety and economic concerns would not be expected to change public perception or be sufficient to encourage new nuclear investments by the utilities. The HTGR offers an attractive alternative, an alternative with proven operating experience and safety characteristics. This is demonstrated in this paper by an assessment of HTGR inherent safety features and by examining Fort St. Vrain operating experience data, which establish the HTGR as a forgiving design with respect to potential accidents. A further quantification of HTGR safety is made from a probabilistic risk assessment (PRA) of the 2240 MWt High-Temperature Gas-Cooled Reactor-Steam Cycle/Cogeneration (HTGR-SC/C) reference plant. These results are compared to NRC risk goals and achieved LWR safety. Finally, a proposed small HTGR reactor design is discussed. Although the relative costs and marketability of such a small reactor have yet to be determined, several additional passive safety characteristics of the small HTGR make such a plant essentially benign.

8654 (ORNL/TM—9327) Simulator experiments: effects of experience of senior reactor operators and of presence of a shift technical advisor on performance in a boiling water reactor control room. Beare, A.N.; Dorris, R.E.; Gray, L.H. (Oak Ridge National Lab., TN (USA); General Physics Corp., Atlanta, GA (USA)). Dec 1984. Contract AC05-84OR21400. 171p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85004778.

This report describes the first experiment in a Nuclear Regulatory Commission-sponsored program of training simulator experiments and field data collection to evaluate the effects of selected performance shaping factors on the performance of nuclear power plant control room operators. The factors investigated were the experience level of the Senior Reactor Operator (SRO) and the presence of a Shift Technical Advisor (STA). Data were collected from 16 two-man crews of licensed operators (one SRO and one RO). The crews were split into high and low SRO-experience groups on the basis of the years of experience of the SROs as SROs. One half (4 of the 8 crews in each group) of the high- and low-SRO experience groups were assisted by an STA or an SRO acting as an STA. The crews responded to four simulated plant casualties which ranged in severity from an uncomplicated turbine trip to an anticipated transient without scram (ATWS). No significant differences in overall performance were found between groups led by high (25

to 114 months licensed as an SRO) and low (1 to 17 months as an SRO) experience SROs. However, crews led by low experience SROs tended to have shorter task performance times than crews led by high experience SROs. Although a tendency for the STA-assisted groups to score higher on four of the five measures was observed, the presence of the STA had no statistically significant effect on overall team performance. The correlation between individual performance, as measured by four of the task performance measures, and experience, measured by months as a licensed operator, was not statistically significant, nor was the correlation between task performance and recency of simulator training. 18 references, 5 figures, 13 tables.

8655 **Parameters for containment hydrogen burn analysis.** Gido, R.G.; Koestel, A. (Los Alamos National Laboratories, P.O. Box 1663 Los Alamos, NM 87545). *Transactions of the American Nuclear Society;* **46**: No. 1, 129-132(1984). (CONF-840813—).

From Design, construction and operation of nuclear power plants conference; Portland, OR, USA (5 Aug 1984).

8656 **Capabilities of HECTR in predicting containment responses during hydrogen combustion.** Dingman, S.E.; Camp, A.L.; Wester, M.J. (Sandia National Laboratories, P.O. Box 5800 Albuquerque, NM 87185). *Transactions of the American Nuclear Society;* **46**: No. 1, 134(1984). (CONF-840813—).

From Design, construction and operation of nuclear power plants conference; Portland, OR, USA (5 Aug 1984).

8657 **Hydrogen diffusion flames in Mark III containments.** Travis, J.R. (Los Alamos National Laboratory, P.O. Box 1663 Los Alamos, NM 87545). *Transactions of the American Nuclear Society;* **46**: No. 1, 136(1984). (CONF-840813—).

From Design, construction and operation of nuclear power plants conference; Portland, OR, USA (5 Aug 1984).

8658 **A TRAC-PF1 analysis of loss-of-fluid test L6-7/L9-2.** Meier, J.K. (Los Alamos National Laboratory, P.O. Box 1663 Los Alamos, NM 87545). *Transactions of the American Nuclear Society;* **46**: No. 1, 140-141(1984). (CONF-840813—).

From Design, construction and operation of nuclear power plants conference; Portland, OR, USA (5 Aug 1984).

8659 **Analysis of a typical BWR/4 MSIV closure ATWS using RAMONA-3B and TRAC-BD1 Codes.** Hsu, C.J.; Neymotin, L.; Saha, P. (Brookhaven National Laboratory, Upton, NY 11973). *Transactions of the American Nuclear Society;* **46**: No. 1, 143-145(1984). (CONF-840813—).

From Design, construction and operation of nuclear power plants conference; Portland, OR, USA (5 Aug 1984).

8660 **Reduction of the damaging effects of hydrogen combustion in nuclear power plants.** Nelson, L.S.; Berman, M. (Sandia National Laboratories, P.O. Box 5800, Albuquerque, NM 87185). *Transactions of the American Nuclear Society;* **46**: No. 1, 127(1984). (CONF-840813—).

From Design, construction and operation of nuclear power plants conference; Portland, OR, USA (5 Aug 1984).

8661 **Post-combustion convection in an intermediate-scale vessel.** Kempka, S.N.; Ratzel, A.C.; Reed, A.W.; Shepherd, J.E. (Sandia National Laboratories, P.O. Box 5800, Albuquerque, NM 87185). *Transactions of the American Nuclear Society;* **46**: No. 1, 125-127(1984). (CONF-840813—).

From Design, construction and operation of nuclear power plants conference; Portland, OR, USA (5 Aug 1984).

8662 **Simulation of LOFT anticipated transient experiments L6-1, L6-2, and L6-3 using TRAC-PF1/MOD1.** Sahota, M.S. (Los Alamos National Laboratory, P.O. Box 1663, Los Alamos, NM 87545). *Transactions of the American Nuclear Society;* **46**: No. 1, 147-149(1984). (CONF-840813—).

From Design, construction and operation of nuclear power plants conference; Portland, OR, USA (5 Aug 1984).

25 ENERGY STORAGE

8663 **(EFN-LET—1983-25) Energy storage. Technical and economical limits for energy storage in the Swedish energy system.** Oejefors, L. (Energiforskningsnaemnden, Stockholm (Sweden)). 1983. 313p. (In Swedish). NTIS (US Sales Only), PC A14/MF A01. File Number TI85750450.

The aim of the report is to estimate the need of energy storage, its volume and economy. Compressed air power plants, batteries and flywheels are treated. The point of view of both the utilities and consumers is discussed. The following aspects have been identified as relevant for the introduction of energy storage systems: - adjustment of loads and power production - load follow-up - service reserve - frequency control - reliability of delivery - voltage control - control of power flow - system planning - reserve power. It is judged that there will be no need of further energy storage before 1990. The international development should be observed. Energy storage might become important after the year 2005 and the following problems would require further development: - the influence on production costs - optimum dimensions and volume - adjustment of loads - economic value of storage - alternatives. Continued development work is necessary and three types of problems should be observed, namely - system-oriented problems which could be treated by utilities - problems which require development of methods and should be performed as a cooperation of universities and utilities - analysis of industrial applications, to be performed by advisers.

2502 Compressed Gas

REFER ALSO TO CITATION(S) 2502008761

2509 Batteries

REFER ALSO TO CITATION(S) 2509008719

8664 **(LBL—17687) Electrochemical processes at the sodium β'' alumina interface.** Mailhe, C.C. (Lawrence Berkeley Lab., CA (USA)). May 1984. Contract AC03-76SF00098. 76p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85004653.

The influences of some impurities including oxygen, calcium and potassium on the polarization at the interface Na/β'' alumina, were studied using a Na/Na cell. At 350°C, the normal operating temperature of the battery and at low current density (30 to 40 mA/cm^2) voltammetry indicated Ohmic interface behavior. Deviations from this behavior occurred only for higher current densities (100 to 150 mA/cm^2) and were accentuated at low temperature (160°C). Oxygen contamination caused an increase in resistance for sodium flowing in the β'' alumina, this effect was explained by a pile-up at the interface of the oxygen present in the sodium and eventually formation of an oxide film, whereas the decrease in resistance associated with fresh sodium flowing out of electrolyte could be attributed to a resultant decrease in oxygen concentration. The addition of vanadium to the sodium decreased the cell resistance. Vanadium is believed to reduce the oxide layer present at the surface of the $\beta''Al_2O_3$. Surprisingly, the addition of CaO, $CaCl_2$, Ca or KCl, which might have been expected to increase significantly the cell resistance did not result in such effects.

8665 **(LBL—18414) Research to explore the feasibility of sulfolanes as electrolytic solvents for rechargeable lithium batteries. Final report.** Foos, J.S.; Rembetsy, L.S.; Brummer, S.B. (EIC Labs., Inc., Norwood, MA (USA)). Sep 1984. Contract AC03-76SF00098. 62p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85004345.

The purpose of this research was to investigate the possible use of sulfolane in Li batteries. The critical parameters were: the conductivity of sulfolane electrolytes, the stability of these electrolytes, and the ability of the electrolytes to cycle Li. Tests were con-

ducted on pure sulfolane electrolytes and on sulfolane electrolytes containing co-solvents.

8666 **(LBL—18574) Research on separators for alkaline zinc batteries. Final report.** Yeo, R.S. (Pinnacle Research Inst., Cupertino, CA (USA)). Oct 1984. Contract AC03-76SF00098. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003082.

This project is concerned with the research and development of a hybrid separator as an improved battery separator in alkaline zinc secondary batteries. Particular emphasis has been directed toward mitigating the failure of zinc electrodes by controlling the permselectivity of the separator. Hybrid separators were synthesized and fabricated. These separators consist of a microporous film, radiation-grafted with a monomer containing ion-exchange groups. The new separator incorporates the favorable aspects of both ion-exchange membranes and microporous separators. Such a hybrid separator should ideally be highly specific for fast transport of electrolyte while inhibiting zincate diffusion. Hybrid separators with a wide range of percent graft (0 to 60%) were made by varying the monomer concentration and radiation time. The grafting of these ionic groups imparts the ion selectivity of the separators. The electrolyte uptake of hybrid separators is ca. 60 wt %. The higher the percent graft of the separator, the higher the water uptake and the lower the KOH uptake that are observed. The permeabilities of zincate ions were measured for a series of hybrid separators.

8667 **Electronically conducting doped chromium oxides.** Crosbie, G.M.; Tennenhouse, G.J.; Tischer, R.P.; Wroblowa, M.S. (Research Staff, Ford Motor Company, Dearborn, Michigan). *Journal of the American Ceramic Society;* 67: No. 7, 498-503(Jul 1984).

Samples of polycrystalline chromium oxide doped with Li_2O, MgO, NiO, and Ta_2O_5 were prepared by hot-pressing to test for suitability as current collector materials of the sulfur electrode in the sodium-sulfur cell. Density, grain size, dopant uniformity, and resistivity (to 350°C) were measured. X-ray photoelectron spectroscopy (XPS) tends to support the established model of Ni^{2+} on Cr^{3+} sites to explain the compositional dependence of electrical resistivity after air anneal. A higher level of Cr_2O_3 powder purity was required to obtain the low resistivities with the Li_2O dopant than with the MgO or NiO dopant. An observed increase in the bulk resistivity during several months of electrochemical cycling in sodium polysulfide/sulfur melts is attributed to loss of electronic carriers caused by equilibration of those carriers with the low oxygen partial pressure of the melt. Li_2O- and (to a lesser extent) MgO-doped Cr_2O_3 appear to be suitable as container coating materials.

29 ENERGY PLANNING AND POLICY

8668 **(NP—5770033) European energy strategy.** (Commission of the European Communities, Brussels (Belgium). Directorate General for Information). Jun-Jul 1984. 12p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number TI85770033.

After an outline of the fundamentals of the European energy strategy, some requirements and recommendations are presented. The goals to be reached are: Promotion of investment activities, a realistic and transparent pricing policy, financial aid to R+D and technological demonstration projects provisions against market destabilisation, and harmonisation of energy policy on an international level.

8669 **(NP—5770035) Canada - energy situation 1983.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Jun 1984. 10p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number TI85770035.

This survey presents some key data on energy production, imports and exports, and some information on the positive trade balance on the mineral oil sector, on energy consumption, on the trends in specific energy consumption, and on the energy trade balance in terms of value.

8670 **(NP—5770038) Tunisia - energy situation 1982/83.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Jun 1984. 8p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number TI85770038.

Very short review of the situation in the fields of: Petroleum, natural gas, electricity, town gas, brown coal, wind and solar energy, biogas.

8671 **(NP—5770059) Republic of Korea - energy situation 1982.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Jul 1984. 12p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number TI85770059.

The energy situation of the Republic of Korea is reviewed on the basis of some relevant data. Its energy policy is commented on, and developments in electric power generation are described as well as the trends observed for the various energy sources. Figures are given on external trade.

2901 Energy Analysis And Modeling

8672 **(Juel-Spez—262) Extension of fuzzy linear programming for multiple objectives.** Correa-Guzman, E.J. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Programmgruppe Systemforschung und Technologische Entwicklung). Jul 1984. 120p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number TI85780227.

The fundamentals and methods of multi-objective programming are outlined. Mathematical definitions and notations are presented, and some important methods of solution are mentioned. The fundamentals of the fuzzy set theory are discussed, followed by a description of the Zimmermann method and an extension of the method to nonlinear correspondence functions. A schematic representation of the method is given. The next chapter describes two studies on multi-objective energy models, carried out at Brookhaven National Laboratory and at Stanford University. The main features of the MARKAL model are outlined, and the results calculated for the above target functions are presented and discussed. The program system developed for the present study is briefly described. The procedures and programs employed are listed in the annex.

8673 **(NP—5750405) Energy, regional development and urban structure.** Arenholt Christensen, B.; Jensen-Butler, C. (Aarhus Univ. (Denmark). Geografisk Inst.). Sep 1981. 105p. (In Danish). NTIS (US Sales Only), PC A06/MF A01. File Number TI85750405.

An analysis is made of the relations between energy planning, specially planning of space heating, and planning of urban structures and systems in the frames of a regional development analysis. The mutual impact between the development of urban structure and the growth of the energy consumption is treated both theoretically and empirically. Specially the question on decentralization of the building pattern is analysed. The discussion is based on Danish experiences, and emperic material on the relation between energy planning and physical planning in Denmark is presented.

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 2902008255, 8291, 8298, 8332, 8684, 8688, 9084, 9413

8674 **(PB—85-101160/XAD) Economic impact of the proposed sulfur dioxide emission regulation, R80-22. Final report.** (Friedman (Bernard S.) and Associates, Chicago, IL (USA)). May 1982. 146p. NTIS, PC A07/MF A01.

This study examines the potential costs and benefits associated with proposed regulation R80-22 which primarily concern a loosening of sulfur dioxide regulations in an effort to increase the use of Illinois coal. The benefits of the regulation consist of fuel cost savings, increased Illinois coal usage and coal miner employment, and a potential for enlarging the State's inventory of attainment areas. The primary cost of R80-22 is the damage to health and

welfare that would result from an increase in SO2 emissions. It was estimated the promulgation of the regulation would increase morbidity, mortality and material costs by $1.032 to $2.434 million annually.

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 2903008185, 8419, 8674, 8677, 9051, 9053, 9061

8675 (BFR-R—110-1983) Good working environment and energy management. Concordant or incompatible requirements in conjunction with industrial planning. Jaegbeck, A.; Lamm, J.; Ranhagen, U. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1983. 183p. (In Swedish). NTIS (US Sales Only), PC A09/MF A01. File Number TI85750444.

The object has been to identify conflicts and interaction potentials between requirements concerning improvements in the working environment and those concerning intensified energy management. As industrial planning takes place at several levels in society, the analysis was carried out at the levels location (in the country and the region), planning of industrial areas and sites, and design of buildings and premises. The investigation indicates that by appropriate location with regard to goods and passenger transport, requirements concerning better traffic safety, less noise and air pollution can be coordinated with those relating to economical management of transport energy. Use of industrial waste heat for heating premises other than those in the factory concerned is another significant opportunity for coordination. The development density and structure of the industrial estate have a direct bearing on requirements relating to good working environment, accessibility, open spaces, wind barriers, etc. and may have great consequences with regard to the possibility of intensified energy management. Judicious vertical and horizontal layout of the industrial building is essential if good working environment and economical energy management are to be achieved, primarily in the case of activities which have moderate or small excess heat. With regard to building design, a number of measures which have a combined effect with regard to working environment and economical energy management have been identified. Economical management of air and a working environment free from air pollution and draughts can be accomplished by certain measures.

8676 (GAO/RCED—84-163) EPA needs to improve its oversight of air pollution control grant expenditures. Bowsher, C.A. (General Accounting Office, Washington, DC (USA). Office of the Comptroller General). 28 Sep 1984. 32p. US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760. File Number TI85900448.

Report to The Chairman, Subcommittee on Oversight and Investigations, Committee on Energy and Commerce, House of Representatives.

At the request of the Chairman, Subcommittee on Oversight and Investigations, House Committee on Energy and Commerce, GAO reviewed EPA's procedures for ensuring grantee compliance with Section 105 provisions and EPA regulations and determined whether grantees are, in fact, meeting these requirements. GAO reviewed all 235 grants awarded from fiscal years 1979 through 1982 at 3 of EPA's 10 regional offices to determine whether consultation, supplementing, and level-of-effort requirements were being met. Those grants represented about 35% of the $340 million in grant funds awarded nationwide during that 4-year period. GAO also reviewed fiscal year 1982 expenditures (the latest data available at the time of GAO's review) for six grantees - two in each of the three regions - to determine whether the grant funds were properly spent and reported. GAO also visited three other grantees for further review after determining that EPA records did not contain a justification as to why those grantees' levels of effort had not been maintained. GAO found that the three EPA regions reviewed were consulting with state officials and were satisfied that supplanting did not occur, as required by the Clean Air Act. On the other hand, GAO found that two of the three EPA regions had not ensured that all grantees complied with the level-of-effort requirement of the act or EPA's reporting requirements. EPA officials believed the problems GAO found could exist in other regions not included in this review.

2904 Natural Resources

REFER ALSO TO CITATION(S) 2904008220, 8491

8677 (GAO/RCED—84-101) Private mineral rights complicate the management of eastern wilderness areas. Bowsher, C.A. (General Accounting Office, Washington, DC (USA). Office of the Comptroller General). 26 Jul 1984. 59p. US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760. File Number TI85900450.

Report to The Congress.

Since 1975, the Congress has expanded the National Wilderness Preservation System to areas of eastern national forest lands. Many of these eastern lands contain significant amounts of private mineral rights; as a result, the Department of Agriculture's Forest Service experienced management and legal problems in trying to preserve these lands and control private mineral development. In addition, recent attempts by the federal government to acquire private mineral rights in eastern wilderness areas have caused considerable controversy and Congressional debate because of the high costs associated with these purchases. These problems could increase because many other areas under consideration for wilderness designation in the east contain private mineral rights. GAO believes that consideration of private mineral rights is important in deciding whether other eastern lands should be designated as wilderness. However, the Forest Service did not provide information regarding private mineral rights and their potential acquisition costs when it submitted wilderness recommendations to the Congress in 1979. Therefore, GAO recommends that the Secretary of Agriculture direct the Forest Service to analyze the potential conflicts and costs associated with private mineral rights in potential wilderness areas and provide this data to the Congress. In addition, GAO believes that the Congress should consider providing further guidance to the Forest Service by specifying what action should be taken regarding private mineral rights in eastern wilderness areas.

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 2905008106, 8356, 8447, 8685, 8717

8678 (CONF-8311209—) Energy research in Berlin. (Industrie- und Handelskammer zu Berlin (Germany, F.R.). Arbeitskreis Energieforschung). 1983. 126p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number TI85770056.

From 2. experts' discussion on energy; Berlin, F.R. Germany (23 Nov 1983).

The volume contains a report on preparatory meetings of study groups, the program of the conference, an introduction and the welcoming and opening addresses, followed by the four papers delivered (including a summary). These are concerned with the aims and activities of the working group 'Energy research in Berlin', the aims of energy research in the Federal Republic of Germany, energy research as an element of technologic development, and energy in the framework of the town policy of Berlin.

8679 (CONF-8405184—) Synthesis of technology transfer methodologies: proceedings. (Meridian Corp., Falls Church, VA (USA)). Dec 1984. 435p. NTIS, PC A19/MF A01; 1; GPO Dep. File Number DE85004635.

From Meridian technology transfer methodologies conference; Washington, DC, USA (30 May 1984).

Objective of the workshop was to reconsider the approaches to technology transfer taken by previous programs on the subject during the 1960s and 1970s for the insight these approaches would provide current Federal program managers. Technology transfer efforts in NASA, National Science Foundation, the Department of Commerce, the Department of Energy (DOE) and in various state-level programs could be measured against the successes or failures of these previous efforts for their relevance today. The workshop, attended by approximately 100 people, addressed a broad range of major issues within technology transfer, including definitional issues, program administration concerns, evaluation and effective-

ness, barriers to communication, and mechanisms for technology dissemination. Numerous specific program histories were scrutinized for the guidance they could provide Federal program managers in the Department of Energy, as well as other agencies.

8680 **(NP—5750433) Plan for basic research in the natural sciences related to the petroleum activities on the continental shelf.** (Norges Almenvitenskapelig Forskningsraad, Oslo). Jun 1982. 191p. NTIS (US Sales Only), PC A09/MF A01. File Number TI85750433.

The plan proposes research projects in the following areas: 1) Physical oceanography 2) geology 3) biology 4) chemical components and processes in the atmosphere 5) material science 6) fluid mechanics 7) underwater acoustics and risk assessment. The plan includes only research which is of direct relevance to current and projected activities on the continental shelf. It aims at supplying the applied natural sciences with the necessary basic research as well as covering fields of the natural sciences relevant for research on the continental shelf. The total funding required to put the plan into action will exceed 200 mill. NOK over a 5 year period.

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 2906008652, 8685, 9038

2907 Transport And Storage

REFER ALSO TO CITATION(S) 2907008663

2908 Waste Heat Utilization

REFER ALSO TO CITATION(S) 2908008711, 8948

8681 **(CONF-840414—1) Efficiency and operational experiences of BHKW systems.** Jost, A. (Maschinenfabrik Augsburg-Nuernberg (M.A.N.) A.G., Augsburg (Germany, F.R.)). Mar 1983. 34p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number TI85770031.

From 1984 Hanover fair; Hanover, F.R. Germany (4 Apr 1984).

After some basic comments on power-heat-coupling (significance for energy policy, definition) and consideration of areas of application for BHKW systems, the various fuels used are defined. Furthermore, a report is given on system design, efficiency, service, operational experiences and recommendations.

2910 Conservation

REFER ALSO TO CITATION(S) 2910008742

8682 **(GAO/RCED—84-200) Overview of selected civilian agencies' progress in achieving energy conservation.** (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 21 Sep 1984. 17p. US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760. File Number TI85900443.

This report provides information on the progress of selected civilian agencies in meeting energy efficiency requirements and achieving energy efficency goals; how actual agency energy conservation initiatives compare with those described in agency energy management plans; the organization and management commitment of each agency to its energy conservation program, including personnel and budget levels; the reliability and accuracy of energy conservation data reported by the agencies; and the potential savings from the implementation of agency plans and conservation measures.

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 2920008289, 8561

8683 **(PB—84-244391) Energy in Rwanda: a synopsis.** Reintsma, M. (Agency for International Development, Washington, DC (USA)). Aug 1981. 40p. NTIS, PC A03/MF A01.

To assess Rwanda's current and projected energy situation, this report summarizes available information on the country's chief actual and potential energy sources and on the Government of Rwanda's (GOR) energy policies and plans.

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 2930008298, 8491, 8674

8684 **(DOE/RG—0062(83)) Electricity exchanges across international borders - 1983.** (USDOE Economic Regulatory Administration, Washington, DC. Office of Fuels Programs). Sep 1984. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85000264.

This report summarizes the electricity exchanges between the US and Mexico and Canada during calendar year 1983. The construction, operation and maintenance of any electric transmission facility which crosses an international border of the United States requires a Presidential Permit. These permits have been granted by the Department of Energy (DOE) since its formation in 1977. Between 1953 and 1977, these permits were issued by the former Federal Power Commission. Prior to 1953, they were issued by the President of the United States. Presidential Permits require that an annual report be filed by the permit holder detailing all transactions with the foreign country.

8685 **(DOE/S—0010(84)) Secretary of Energy annual report to Congress.** (USDOE, Washington, DC). Sep 1984. 229p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE85000347.

This report describes the policies and the programs of the Department of Energy through September, 1984. Discussion is presented under the headings: Secretary's Statement; Energy Conservation; Renewable Energy Resources; Fossil Energy; Nuclear Energy; Civilian Radioactive Waste Management; Energy Supportng Research; General Sciences; Environment, Safety, and Health; Energy Production; Emergency Preparedness; International Programs; Nuclear Non-proliferation; Defense; Energy Information; Economic Regulation; and Departmental Administration. Appendices contain information on foreign direct investment in US energy, exports of energy resources by foreign companies, disclosure of energy assets by DOE employees; financial assistance programs and hearings and appeals. Separate abstracts have been prepared for each main topic for inclusion in the Energy Data Base. 50 figures, 37 tables. (DMC)

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 2940008255, 8261, 8261, 8289, 8290, 8291, 8291, 8292, 8298, 8307, 8308, 8332, 8356, 8674, 8677, 8677, 8677, 8680, 8680, 8685

8686 **(NP—5770030) New aspects of coal application as an energy carrier and a raw material for the chemical industry with particular reference to the situation in Switzerland.** Funk, H.J. (Hochschule St. Gallen fuer Wirtschafts- und Sozialwissenschaften (Switzerland)). 11 Jul 1983. 175p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number TI85770030.

Coal as an energy carrier and base material for chemical raw materials has met with greater interest in Switzerland in recent time again following a number of decades during which it held but a modest marginal position. The book on hand examines the potentialities offered by coal, relates these to today's basic situation of energy economy on an international level and, in particular, con-

cerning the situation in Switzerland while taking into account marginal conditions of ecology and practical technology, and, deduced from this, it outlines the potential dimensions of a future utilization by means of practical examples. Along with a demonstration of well-known conventional technologies, i.e. coal application in boiler heating facilities for generating heat and power, particular significance is placed with more developed and sophisticated technologies of coal utilization and upgrading. An overview is given on the state of the art of technology, on today's global situation concerning the introduction of corresponding technologies on a commercial scale, and an assessment of future prospects is made under aspects of energy economy. As a conclusion, some suggestions for a utilization of new technologies in Switzerland are developed.

8687 **(NP—5770054) Deutscher Verband Fluessiggas e.V. (DVFG): Annual report 1983.** (Deutscher Verband Fluessiggas e.V. (DVFG), Kronberg im Taunus (Germany, F.R.)). 1984. 31p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number TI85770054.

Against the background of a description of the situation of the liquefied natural gas economy and the market, the structure and activities of the association are explained. The association has the tasks to assure the constant, economical, and safe supply of consumers with liquefied natural gas, to work out bills, guidelines and recommendations, to promote the liquefied natural gas community in the special scientific fields of work and to advise its members in all questions of technology, economy, and law.

2950 Hydrogen And Synthetic Fuels

8688 **(BNL—35372) Effect of revised fuel price projections on the choice of energy technologies in the MARKAL model of the United States.** Hill, D.; Kahn, A. (Brookhaven National Lab., Upton, NY (USA)). Dec 1983. Contract AC02-76CH00016. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004709.

In the International Energy Agency project on energy technology systems analysis (ETSAP), fuel price projections were made in 1981 as assumptions to be used in running the MARKAL models of energy systems of the fourteen participating countries. At that time, prices were assumed to increase continuously from 1980, whereas in fact there has been a decline in oil price. To test the results of a low oil price in the 1985 to 1990 time period, additional runs were made of the MARKAL model of the US with new price assumptions for the two basic scenarios: a high price, low demand scenario and a low price, high demand scenario. The principal difference in the results is a decline in coal liquefaction processes which appear only in the high price scenario. The Mobil M process is dropped, and coal-to-methanol and the use of methanol in automobiles is reduced. Coal hydroliquefaction, which produces a crude oil equivalent and by-product gas, continues to be used starting in 2005. The need for other technologies that substitute for imported oil - shale oil and enhanced recovery - is delayed or diminished. On the other hand, technologies that are frugal in the use of oil - improved Otto-cycle automobiles and improved burners retrofitted in oil-heated residences - prove to be more important because the replacement of oil as a fuel is delayed. Except for these differences, there is no substantial change in the ranking of new technologies shown for the US in the ETSAP Phase 3 report which is based on their potential for reducing energy system cost. 5 references, 4 figures, 4 tables.

8689 **(GAO/RCED—84-98) Procedures need strengthening in the US Synthetic Fuels Corporation's conflict of interest program.** (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 20 Sep 1984. 35p. General Accounting Office P.O. Box 6015, Gaithersburg, MD 20760. File Number TI85900502.

Report to the Chairman, Subcommittee on Oversight and Investigations, Committee on Energy and Commerce, House of Representatives.

GAO reviewed the appropriateness of the US Synthetic Fuels Corporation's criteria for identifying confidential information and, by using one case study, the consistency by which these criteria have been applied. Also, GAO reviewed the Corporation's program to assist its directors, officers, and employees in avoiding conflicts of interest. GAO found that the Corporation's criteria for identifying confidential information are consistent with the purposes of the Freedom of Information Act in protecting certain information from public release and that the Corporation, for the most part, consistently applied its criteria for identifying confidential information on the First Colony project. GAO did, however, identify weaknesses in the Corporation's conflict of interest program, including key employees and contractors not filing reports of their financial interests, insufficient monitoring of officers' and employees' financial interests, and conflict of interest determinations being inconsistently made or inadequately documented in the Corporation files. GAO makes recommendations to correct these weaknesses.

2960 Electric Power

REFER ALSO TO CITATION(S) 2960008290, 8462, 8472

8690 **(DOE/EIA—0040(84)) Typical electric bills, January 1, 1984.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). Dec 1984. 356p. NTIS, PC A16/MF A01 - GPO; GPO Dep. File Number DE85005150.

These surveys provide comprehensive coverage of the cost to consumers for representative amounts of electricity used per month for residential, commercial, and industrial service in most of the Nation. Bills for residential electric service are reported for five different energy consumption levels in all communities with populations of 2500 or larger. For commercial and industrial service, bills are presented for large cities. Commercial bills are shown for six combinations of billing demands in kilowatts (kW) and monthly consumption levels in kilowatthours (kWh); industrial bills cover five billing demands and ten consumption levels. The bill categories were chosen to represent various usage levels in each community and the choices are discussed in detail in the individual chapters. Present long-term trends and current levels of average electric bills for the residential sector are shown for the total United States, for each State, the District of Columbia, and for the nine Census Divisions. Detailed information on bills for the three types of service in the individual communities as of January 1, 1984 are shown.

8691 **(DOE/IG—0214) Audit report on Western Area Power Administration's purchase of a jet fixed-winged aircraft.** (USDOE Office of Inspector General, Albuquerque, NM. Western Regional Office). 5 Dec 1984. 57p. OSTI. File Number TI85003276.

Report to The Secretary.

We reviewed Western Area Power Administraion's (Western) purchase of a jet fixed-winged aircraft for official travel purposes. We found that the decision to purchase the aircraft was made without an adequate determination of need; without the required cost analysis prescribed by the Office of Management and Budget (OMB) and Department regulations; and without a valid justification demonstrating lack of suitable commercial air service, improved productivity, reduced travel cost, and emergency crew dispatch.

8692 (EPRI-EA—3587, pp S.1-S.30) **Summary: the Demand and Conservation Program.** Gellings, C.W. (Electric Power Research Inst., Palo Alto, CA). Jun 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920503. (CONF-8305212—; CONF-8307130—).

From EPRI seminar on annual review of demand and conservation research; Arlington, VA, USA (17 May 1983).

The organization, activities, products, and the personnel of the Demand and Conservation Program of EPRI are described. The Demand and Conservation Program focuses its research efforts on: (1) long- and short-term load shape and demand forecasting; (2) evaluation of demand-side planning alternatives available to the utilities; (3) consumer research techniques; and (4) rate design and analysis. Many decisions facing the utilities relate to minimizing capital investment over the long term while providing the mandated services in the short term. The program is designed to provide

the demand-side data and tools needed in the course of making such decisions.

8693 (EPRI-EA—3587, pp 1.1-1.48) **Hourly Electric Load Model (RP1955): model design and load management applications.** Dickson, C.; Inglis, M. (ICF Inc., Washington, DC). Jun 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920503. (CONF-8305212—; CONF-8307130—).

From EPRI seminar on annual review of demand and conservation research; Arlington, VA, USA (17 May 1983).

Accurate forecasts of hourly system load shapes are an important input to load management planning. The Hourly Electric Load Model (HELM), currently under development by EPRI, is designed to provide hourly load forecasts over a 5 to 30 year planning horizon. The model uses a structural, bottom-up approach. Hourly system loads are developed by aggregating over a flexible number of end-use loads. End uses can represent rate classes, appliance types, SIC classifications, or any other useful grouping of loads. Weather sensitive loads can be modeled under two alternative approaches. The model forecasts load shape impacts of conservation programs, load management policies, rate structure changes, need technologies, and changes in the mix of end-uses over time. An audiovisual presentation of the model structure, data requirements, and outputs is described. The use of the model in forecasting the hourly load impacts of load management, alternative rate forms, and weather effects is also described.

8694 (EPRI-EA—3587, pp 2.1-2.54) **Industrial process models.** Pierce, B.L.; Sparrow, F.T. (Brookhaven National Lab., Ithaca, NY). Jun 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920503. (CONF-8305212—; CONF-8307130—).

From EPRI seminar on annual review of demand and conservation research; Arlington, VA, USA (17 May 1983).

The industrial sector of the US economy has historically accounted for a large share of the nation's energy use. In 1955 this share was 48.5% and 19 quadrillion Btu's. Since then the industrial sector's share has been dropping while the amount of energy consumed has increased. In 1980, the industrial sector consumed 40% or 30 quadrillion Btu's of the energy consumed in the US. Interest in new technologies and how the penetration of new technologies might affect energy use and fuel mix led to the development of industrial process models. The models allow an assessment to be made of the probable impact of introducing specific process technologies into production facilities. Market penetration rates of new technologies, energy use, and fuel mix can be generated under varying tax policies, fuel price projections, product demand projections, technology cost assumptions, and alternative technology availabilities. The rationale, methodology, and performance of the model are described.

8695 (EPRI-EA—3587, pp 3.1-3.20) **Customer attitudes, response, and transferability: a guide to the Rate Design Study - phase IV.** Breese, J.S.; Miller, K.A. (Electric Power Research Inst., Palo Alto, CA). Jun 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920503. (CONF-8305212—; CONF-8307130—).

From EPRI seminar on annual review of demand and conservation research; Arlington, VA, USA (17 May 1983).

EPRI research on unresolved issues related to earlier phases of the Rate Design Study (RDS) is described. The activities related to the RDS are described and some preliminary results of the research are given. Previous phases of the RDS have been primarily concerned with the feasibility and effectiveness of load management (time-of-use rates, direct load control etc.) as a strategy for reducing rising costs of power supply. The work involved in this study consisted of: (1) assessment of customer attitudes and response to load management; (2) assessment of alternative techniques and issues in load data transfer; and (3) assessment of alternative techniques and issues in transferring data on customer response to time-of-use ratio and direct load control programs. Each of these projects is discussed in detail.

8696 (EPRI-EA—3587, pp 4.1-4.22) **Transferability of customer response to residential time-of-use electricity prices.** Caves, D.W.; Cristensen, L.R.; Herriges, J.A. (Laurits R. Cristensen Associates, Inc., Madison, WI). Jun 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920503. (CONF-8305212—; CONF-8307130—).

From EPRI seminar on annual review of demand and conservation research; Arlington, VA, USA (17 May 1983).

The goal of transferability is to develop a model that utilities can use to simulate changes in residential customer loads in response to time-of-use pricing. An important aspect of the model is to relate the changes in load to the characteristics of the service area, including appliance holdings, customer demographics, and climate. A model of this type is required for cost-benefit analysis of residential time-of-use pricing. The development of the model is discussed under the following topics: problems in transferability research, research strategy, considerations in using the model, data used, methodology, and results.

8697 (EPRI-EA—3587, pp 5.1-5.26) **Potential effects of TOU rates for selected industrial/commercial customers: a project overview with preliminary estimates (RP2043-1).** Miedema, A.K.; Lee, K.K. (Research Triangle Inst., Research Triangle Park, NC). Jun 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920503. (CONF-8305212—; CONF-8307130—).

From EPRI seminar on annual review of demand and conservation research; Arlington, VA, USA (17 May 1983).

Many electric utilities have already implemented or are seriously considering time-of-use (TOU) rates for large industrial and commercial customers. Therefore, the need for improved knowledge about the impacts of these rate changes has become important and wide-spread. EPRI decided to develop further information in this area. A project was devised to design, develop, and demonstrate a reliable methodology to project short- and long-term responses of large power customers to TOU rates. Some of the analysis results developed to date, as well as plans for future research, are described.

8698 (EPRI-EA—3587, pp 6.1-6.25) **Weather normalization of residential electricity sales.** Train, K.E.; Ignelzi, P.; Engle, R.; Granger, C.; Ramanathan, R.; Rice, J. (Cambridge Systematics, Inc., Berkeley, CA). Jun 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920503. (CONF-8305212—; CONF-8307130—).

From EPRI seminar on annual review of demand and conservation research; Arlington, VA, USA (17 May 1983).

Because of the large impact of weather on electricity use, utilities and their regulators are concerned with weather patterns in their analysis of electricity sales. Utilities find it useful, and often necessary, to quantify the excess or loss of sales generated by unusual weather conditions. Statistical models are presented and examined that described the effect of weather on electricity sales. The models can be used to normalize monthly sales data for abnormalities in the weather. The development and performance of the statistical models are discussed.

8699 (EPRI-EA—3587, pp 7.1-7.12) **Commercial end-use survey design (RP1216-4).** Dohrmann, D.R.; McCarthy, P.M. (ADM Associates, Inc., Sacramento, CA). Jun 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920503. (CONF-8305212—; CONF-8307130—).

From EPRI seminar on annual review of demand and conservation research; Arlington, VA, USA (17 May 1983).

The major results of a study undertaken for EPRI to examine the use of sampling techniques for collecting end-use data on commercial customers of electric utilities are presented and discussed. The focus of the study was on those steps of a sample survey relating to the development of sampling plan. The topics addressed include those pertaining to sampling frame development, sample size determination, population stratification and analysis, and sample design and estimation.

8700 (EPRI-EA—3587, pp 8.1-8.34) **Development and implementation of a commercial energy and peak demand end-use forecasting model.** Lann, R.B.; Riall, B.W.; Jackson, J.; Johnson, W.S. (Georgia Inst. of Tech., Atlanta). Jun 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920503. (CONF-8305212—; CONF-8307130—).

From EPRI seminar on annual review of demand and conservation research; Arlington, VA, USA (17 May 1983).

In February 1981, EPRI contracted with the Georgia Institute of Technology to develop a utility service area version of a widely used commercial sector end-use energy demand model. The principal objectives of the study were: (1) to expand the model structure to improve space heating fuel and efficiency choice and to incorporate an end-use level peak demand model; (2) to provide an implementation guide for the model; (3) to catalog and summarize available public data sources; and (4) to describe the implementation accomplished at Georgia Power Company and Long Island Lighting Company. The accomplishments in these areas are summarized.

8701 (EPRI-EA—3587, pp 9.1-9.20) **Residential End-Use Energy Planning System.** Goett, A.A. (Cambridge Systematics, Berkeley, CA). Jun 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920503. (CONF-8305212—; CONF-8307130—).

From EPRI seminar on annual review of demand and conservation research; Arlington, VA, USA (17 May 1983).

The development of the Residential End-Use Energy Planning Systems (REEPS) computer code and the supporting statistical analysis are described. REEPS is a microsimulation model of household energy use patterns. The model forecasts appliance holdings, operating characteristics, and energy usage for light end-uses and three major fuel categories. REEPS forecasts energy choices for a large number of market segments representing households with different socioeconomic, dwelling, and geographical characteristics.

8702 (EPRI-EA—3587, pp 10.1-10.19) **Evaluation of residential conservation programs.** O'Keefe, J.C.; Hartman, R.S. (Arthur D. Little, Inc., San Francisco, CA). Jun 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920503. (CONF-8305212—; CONF-8307130—).

From EPRI seminar on annual review of demand and conservation research; Arlington, VA, USA (17 May 1983).

The potential use of energy conservation as a substitute for both the increased use of fossil fuels and the continued growth of electric utility generating capacity is discussed. While conservation actions are being pursued by a broad cross section of individuals and firms, the electric utility industry has been particularly aware of the desirability of energy conservation. Because of the importance of conservation to the overall development of cost-effective and reliable electric service to the customers of the electric power industry, EPRI sponsored research designed to develop a comprehensive methodology to formally evaluate the impact of residential conservation programs. The results of the study are presented and discussed.

8703 (EPRI-EA—3587, pp 11.1-11.28) **Modeling to provide customer information on end-use electricity consumption (RP863).** McCarthy, P.M. (Applied Management Sciences, Inc., Silver Spring, MD). Jun 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920503. (CONF-8305212—; CONF-8307130—).

From EPRI seminar on annual review of demand and conservation research; Arlington, VA, USA (17 May 1983).

Information on the electric power consumption of residential end-uses has become increasingly important to electric utilities over the last decade. For several years, recognition of this importance has been growing among utility planners responsible for forecasting electric load growth. Many of them have begun to forecast load growth using methods based on end-use consumption data. Recognition of the importance of residential end-use information is also beginning to emerge among the utilities' marketing and customer relations staffs. A study was undertaken by EPRI to identify and summarize existing methods of gathering and using residential end-use information; assess existing methods for gathering and using residential end-use information; and to make recommendations to EPRI for research and development activities to improve the electric utilities' ability to use end-use information for residential marketing and customer relations purposes. The results of the study are presented and discussed.

8704 (EPRI-EA—3587, pp 12.1-12.35) **Residential end-use load shapes (RP2145).** Mehra, R.K.; Train, K. (Scientific Systems Inc., Cambridge, MA). Jun 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920503. (CONF-8305212—; CONF-8307130—).

From EPRI seminar on annual review of demand and conservation research; Arlington, VA, USA (17 May 1983).

An audiovisual presentation was made on residential end-use load shapes. The objective of the presentation was to select, develop, demonstrate, and transfer to utilities a model for residential end-use load shape estimation. The work plan, overall approach, and modeling techniques are shown.

8705 (EPRI-EA—3587, pp 13.1-13.10) **Load data transferability (RP1820).** Linder, K.P. (ICF Inc., Washington, DC). Jun 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920503. (CONF-8305212—; CONF-8307130—).

From EPRI seminar on annual review of demand and conservation research; Arlington, VA, USA (17 May 1983).

Load data transfer is a procedure whereby electric utility load data are modified to reflect conditions other than those under which the data were collected. The modified, or transferred, data can substitute for metered load data. An analytical framework is presented for transferring utility load data and for applying the framework in transferring residential loads. The following issues are addressed: what are the alternative approaches to load data transfer; what are the important criteria to be satisfied in choosing a donor utility; what are the important factors which affect customer loads; what are the accuracy requirements for load data used in utility analyses; and what are the data and analytic requirements necessary to affect load data transfer. These issues are discussed in detail.

8706 (EPRI-EA—3587, pp 14.1-14.12) **Transferability of direct load control program results.** Hirshberg, A.S.; Hass, S.A.; Moskovitz, M.H. (Booz, Allen and Hamilton, Inc., Bethesda, MD). Jun 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920503. (CONF-8305212—; CONF-8307130—).

From EPRI seminar on annual review of demand and conservation research; Arlington, VA, USA (17 May 1983).

Over the past few years utilities have increasingly looked to direct load control as an option for addressing specific utility planning and operating needs. Before a utility implements a direct load control program it must estimate the benefits and costs that are likely to result. Before a direct load control program is initiated the following issues must be addressed: overall program planning and design, customer maketing and acceptance, hardware selection and installation, system operation and maintenance, data collection and analyses, and go or no-go decision. The benefit of this analysis is that a simple and easily understood tool for utilities to use for planning and assessment of direct load control programs will be available.

8707 (EPRI-EA—3587, pp 15.1-15.20) **Implementing electric utility energy conservation programs: lessons of experience (RP2050-11).** Davis, T.; Lamaye, D. (Synergic Resources Corp., Seattle, WA). Jun 1984. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920503. (CONF-8305212—; CONF-8307130—).

From EPRI seminar on annual review of demand and conservation research; Arlington, VA, USA (17 May 1983).

An audiovisual presentation was made on the implementation of electric utility energy conservation programs. The background for the study, project objectives, approach, candidate utilities, utility environmental/conservation program linkages, significance of state regulatory intervention, influences of utility system characteristics, types of conservation programs, technical assistance

programs, financial incentives, and conservation program planning are discussed.

8708 **(PB—84-232248) Applications of hierarchical control systems.** Singh, M.G.; Mahmoud, M.S.; Hassan, M.F.; Titli, A. (Manchester Univ. (UK). Inst. of Science and Technology). 1984. 11p. NTIS, PC E03/MF E03.

Prepared in cooperation with Centre National de la Recherche Scientifique, Toulouse (France). Laboratoire d'Automatique et de ses Applications Spatiales, Kuwait Univ., Safat. Dept. of Electrical and Computer Engineering, and Cairo Univ., Giza (Egypt). Dept. of Electrical and Computer Engineering.

This paper reviews applications of hierarchical modelling, control, and optimization to various systems of practical interest. The areas considered are in the fields of power systems management and control, industrial automation, biological processes, oversaturated traffic networks, congested motorway traffic, and water resource systems.

2980 Consumption And Utilization

REFER ALSO TO CITATION(S) 2980008290

8709 **(DOE/EIA—0321/2(82)) Residential Energy Consumption Survey: consumption and expenditures, April 1982 through March 1983. Part 2. Regional data.** Thompson, C. (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 5 Dec 1984. 317p. NTIS, PC A14/MF A01; 1 - GPO; GPO Dep. File Number DE85003997.

This report is the third in a continuing series of reports presenting data from the 1982 Residential Energy Consumption Survey (RECS). Included here are data, at the Census region and division level, for consumption and expenditures of the major fuels used in the household - electricity, natural gas, fuel oil/kerosene, and liquefied petroleum gas (LPG). Data are also presented for wood consumption. This report includes a summary of the highlights within each of the four Census regions: Northeast, North Central, South, and West. A map of the states included in a region may be found at the beginning of the summary for that region. Tables displaying the data by Census region and division follow the summary. 32 figures, 28 tables.

8710 **(EPRI-EA—3736) Linking market planning to corporate objectives: a utility case study. Final report.** Diamond, M. (Booz, Allen and Hamilton, Inc., Bethesda, MD (USA)). Nov 1984. 66p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $10.00. File Number TI85920149.

This report presents the results of a study of innovative planning methods for the utility industry sponsored by EPRI. The study was designed to identify and evaluate planning techniques in use outside the utility industry, or discussed in the literature, which could be useful to utility planners and decisionmakers. In the initial phase of the project, a broad scan of promising techniques was conducted and the results reviewed with a panel of industry officers and managers. The group identified several techniques for potential future research. In subsequent phase of the project, two utilities: Consumers Power Co., and Georgia Power Co., participated in case studies to evaluate specific techniques applied to actual utility decisions. In the Consumers Power case a combination of techniques were used to assess a portfolio of market programs by linking them to the company's corporate goals and strategies. Georgia Power Company utilized market research and segmentation analysis techniques to assess a totally new product/service concept with limited prior data.

8711 **(NP—5750406) Statistics 1981.** (Danske Fjernvarmevaerkers Forening, Kolding). 1981. 25p. (In Danish). NTIS (US Sales Only), PC A02/MF A01. File Number TI85750406.

The statistics prepared by the Danish District Heating Association describes in figures and curves the trend of the latest years of the district heating sector. There are data on fuel consumption; the ditribution of the different fuels for heat production; the trend of prices of the production of heat and of the fuels; and the production capacity of all district heating plants in Denmark.

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 2990008458, 8491, 8685, 8781, 8784

8712 **(LA—10212-MS) Evaluation of the St. Lucia geothermal resource: macroeconomic models.** Burris, A.E.; Trocki, L.K.; Yeamans, M.K.; Kolstad, C.D. (Los Alamos National Lab., NM (USA)). Aug 1984. Contract W-7405-ENG-36. 89p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85005229.

A macroeconometric model describing the St. Lucian economy was developed using 1970 to 1982 economic data. Results of macroeconometric forecasts for the period 1983 through 1985 show an increase in gross domestic product (GDP) for 1983 and 1984 with a decline in 1985. The rate of population growth is expected to exceed GDP growth so that a small decline in per capita GDP will occur. We forecast that garment exports will increase, providing needed employment and foreign exchange. To obtain a longer-term but more general outlook on St. Lucia's economy, and to evaluate the benefit of geothermal energy development, we applied a nonlinear programming model. The model maximizes discounted cumulative consumption. For the next 30 years, results show a 3% per year increase in GNP that is relatively insensitive to whether geothermal energy is installed or whether the price of oil increases by as much as 2% per year. If geothermal energy is installed, discounted cumulative consumption is increased by 2% to 4% and annual consumption by 3% to 9% by 2012, depending on the price of oil. In addition, installation of geothermal capacity markedly decreases energy costs and the demand for imported petroleum. With geothermal, energy costs as a percentage of GNP are decreased, thus leaving more funds to be spent for consumption and investment.

8713 **(NP—5750421) Combined renewable energy systems. Economic evaluation for villages with surroundings.** Rasmussen, F.; Rasmussen, H.Chr. (Odense Univ. (Denmark). Lab. for Energiforskning). Feb 1983. 72p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. File Number TI85750421.

Viability of a combined central heating-power plant based on renewable energy sources is analyzed. Village investment depends on the actual real interest and possibilities of capital supplies as well as fossil fuel prices.

8714 **(NP—5770004) Economic aspects of biogas production in agriculture.** Frick, G. (Hochschule St. Gallen fuer Wirtschafts- und Sozialwissenschaften (Switzerland)). 1983. 196p. (In German). NTIS (US Sales Only), PC A09/MF A01. File Number TI85770004.

The biogas technology is discussed under economic aspects. The dissertation has two main parts. The technical part, which is short and not very detailed, describes the biochemical fundamentals and process technology of biogas production. The economic part analyzes the technology and its components with a view to the consequences for the cost and benefits of the overall system. Standards are set, and their feasibility is studied. A short practical section describes some existing systems and their economic effects.

8715 **(PB—85-101392/XAD) Economic costs of renewable energy. Final report.** Gorden, R.; Gorden, M.; Reckhow, S. (Development Sciences Corp., Inc., Sagamore, MA (USA)). 2 Apr 1981. 112p. (DS—135.12). NTIS, PC A06/MF A01.

Are renewable energy systems (RES's) economically competitive with fossil fuels in developing countries. Underlying this question are several assumptions which this report reviews and tests, using a net present cost analysis method, in three case studies - a water-pumping system, rural electrification, and gasohol as a gasoline substitute - for the period 1980-95. The authors conclude that the key assumption that RES's will become increasingly competitive as oil prices rise is essentially true, provided that RES's can be developed on a sufficiently small scale. The authors warn, however, that extrapolation of study results is limited because of the site-specificity of most RES's.

8716 **(SI—4-1979) Marginal wood resources in Denmark. Potential quantities, geographical distribution, and the economy of utilization as fuel for heating purposes.** Skyum, J. (Skovteknisk Inst., Copenhagen (Denmark)). 1979. 53p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. File Number TI85750423.

Marginal wood resources are defined as the wood that are not used in industry or as firewood and as waste wood. The total Danish potential marginal wood resources are about 1.6 million m^3/year. The potential yearly energy content of these resources is about 12 million GJ which is equivalent to 260000-316000 tons of heavy fuel oil. With this amount of energy 85000-105000 houses can be heated. The economic analysis shows that a utilization of the marginal wood resources for space heating generally is profitable compared with utilization of oil.

8717 **(STEV-SB—83-34) Establishing the future know-how on the use of wood for fuelling.** Kilander, K. (Statens Energiverk, Stockholm (Sweden)). Jun 1983. 30p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number TI85750453.

Wood is a traditional fuel in Sweden. Lately it has got a certain renaissance mainly in terms of waste wood and logging slash for fuelling. Consequently R and D-activities were initiated in order to secure an adequate up-to-date technology. The usage of domestic energy sources has also been favoured through state support and subventions. This report is systemizing necessary research on wood fuel and its integration into adjacent fields. Different users of the research results and their likely attitudes are commented upon. Main conclusions are: (a) It is to-day widely accepted that wood for fuelling is an alternative to be considered and properly evaluated for possible use. (b) Necessary technical know-how will certainly be available also in the long run. The wood-fuel aspects are parts of developments in soil ecology, wood harvesting technique, combustion etc. (c) So far the quality of the economic analyses involved has been low. It is of utmost importance to strengthen this for the future. (d) In the long run at laest parts of this biomasse might be used for new products. Such a development would ask for forecasts on likely raw-material costs. Financers of this R and D will have three alternatives from the administrative point of view. Present project can be kept as a separately financed activity attached to the University of Agricultural Sciences as it is to-day. It could also be integrated in the University on a permanent basis and amalgamated in the same budget. Thirdly a separate institute could be formed, preferably on a somewhat broader basis covering all biomasse for fuelling. Pros and cons for these solutions are discussed.

30 DIRECT ENERGY CONVERSION

3001 Mhd Generators

8718 **(ANL/EES-TM—267) Experimental investigations of thermal radiation from potassium atoms in magnetohydrodynamic systems: preliminary report.** Wang, C.S.; Chow, L.S.H.; Johnson, T.R. (Argonne National Lab., IL (USA)). Sep 1984. Contract W-31-109-ENG-38. 29p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85003715.

The effect of potassium atoms on gas radiation was experimentally investigated. Test data were interpreted by a radiant heat transfer model that calculates the effective gas emissivity and absorptivity from carbon dioxide, water vapor, and potassium atoms and the resulting heat flux. Combustion tests both with and without potassium were conducted. For combustion gases without potassium, the gas emissivities calculated using the model were in good agreement with those obtained from the Hottel charts. For combustion gases with potassium, the radiant heat fluxes calculated using the model were in reasonable agreement with the measurements. Using the partially validated radiant heat transfer model, calculations were performed to provide gas emissivity data (from carbon dioxide, water vapor, and potassium atoms) for magnetohydrodynamic components with mean beam lengths up to 9.1 m (30 ft).

3005 Fuel Cells

REFER ALSO TO CITATION(S) 3005008455, 8540, 8570

8719 **(AD-A—145416/4) Fuel cells and batteries employing polyacetylene electrodes in aqueous electrolytes. Interim technical report.** MacDiarmid, A.G.; Mammone, R.J.; Somasiri, N.L.D.; Krawczyk, J.R. (Pennsylvania Univ., Philadelphia (USA). Dept. of Chemistry). Apr 1984. 16p. NTIS, PC A02/MF A01.

Presented at the Energy Technology Conference (11th), 19-21 Mar 84, Washington, DC.

These studies show that an organic polymer such as polyacetylene has the capability of acting as an electrocatalytic electrode for the spontaneous reduction of gaseous oxygen at one atmosphere pressure and at room temperature in aqueous acid media. They also show that p-doped polyacetylene can act as an electrode-active cathode material for rechargeable battery cells in certain aqueous electrolytes. These observation suggest that a large new area, not only of fundamental scientific interest but also of possible potential technological importance, may exist involving the aqueous electrochemistry of (CH)x and also other conducting polymers.

8720 **(AD-A—145477/6) P-doping of (CH)x to the metallic regime with gaseous oxygen. Application to oxygen fuel cell type electrodes. Interim technical report.** Mammone, R.J.; MacDiarmid, A.G. (Pennsylvania Univ., Philadelphia (USA). Dept. of Chemistry). May 1984. 26p. (TR—84-5). NTIS, PC A03/MF A01.

Trans-polyacetylene, (CH)x, can be p-doped (oxidized) to the metallic regime by gaseous oxygen in the presence of an aqueous solution of a non-oxidizing acid such as HBF4. The oxygen oxidizes the (CH)x to (CH(+y))x while the HBF4 supplies a stable fluoroborate counter anion to give a species such as (CH(+y)A(-y)x. The doping process is consistent with the reduction potentials of (CH)x and O2 in acid solution. In the absence of the acid, oxygen reacts irreversibly with the semiconducting (CH)x to destroy its conductivity.

8721 **(DOE/MC/19077—T4) Development of a hot gas cleanup system for integrated coal gasification/molten carbonate fuel cell power plants. Monthly project status report No. 21, November 1-November 30, 1984.** Lyke, S.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1984. Contract AC21-82MC19077. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85005067.

The overall objective of this project is to conduct research and development to demonstrate the Solid-Supported Molten Salt (SSMS) Process for removing HCl and sulfur compounds from hot, pressurized fuel gas. Specific objectives are to: (1) demonstrate at the bench scale that the SSMS Process can remove H_2S, COS, and HCl to less than 1 ppM; (2) provide performance data in sufficient detail to allow scale-up and economic evaluation of the process; (3) design a scaled-up test absorber suitable for use with a pressurized fluidized-bed gasifier with 150 lb/h of coal throughput; and (4) complete a conceptual design and capital and operating cost estimate for a commercial-scale absorber system. Progress is reported.

8722 **(DOE/METC/SP—203) Fuel cells.** (USDOE Morgantown Energy Technology Center, WV). Dec 1983. 55p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE84003076.

The lead role in the US DOE fuel cell research and development program has been assigned to the Morgantown Energy Technology Center (METC). A description of the history, operation, types, and performance of fuel cells is given. Fuel cell programs being implemented by METC are discussed including the Phosphoric Acid Fuel Cell Program, the Molten Carbonate Fuel Cell Program, the Solid Oxide Fuel Cell Program, and the Fuel Cell Advanced Research and Technology Development Program. (WHK)

8723 **(DOE/NASA—0017-1) Phosphoric acid fuel power plant system performance model and computer program.** Alkasab, K.A.; Lu, C. (Cleveland State Univ., OH (USA)). Jan 1984. Contract AI21-80ET17088. 130p. (NASA-CR—174638). NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85003070.

A FORTRAN computer program has been developed and is presented for analyzing the performance of phosphoric acid fuel cell power plant systems. Energy mass and electrochemical analysis in the reformer, the shift converters, the heat exchangers, and the fuel cell stack were combined to develop a mathematical model for the power plant for both atmospheric and pressurized conditions, and for several commercial fuels.

8724 **(LBL—18542) Transition metal macrocycles and related complexes as catalysts for oxygen electrodes. Final report.** Aldred, W.; Fierro, C.; Gupta, S.; Simic-Glavaski, B.; Yeager, E. (Case Western Reserve Univ., Cleveland, OH (USA)). Oct 1984. Contract AC03-76SF00098. 138p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85004439.

The overall objective of this research is the development of high activity stable catalysts for O_2 reduction in acid electrolytes using transition-metal macrocycles and related complexes. The research approach involves the understanding of the mechanism and kinetics of O_2 reduction on these macrocycles in relation to their structure and the use of this information to arrive at optimum catalyst systems. The research during the second year has continued to involve (1) the fundamental aspects of the macrocycles adsorptively attached to the electrode surfaces and in solution, and (2) the thermally treated macrocycles whose structures have been degraded but nonetheless exhibit high catalytic activity in acid and alkaline electrolytes and long-term stability. In the fundamental studies, much emphasis has been placed on the further purification and characterization of the iron- and cobalt-porphyrins and phthalocyanines including the tetrasulfonated phthalocyanines during this period.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 3200008682

3201 Buildings

REFER ALSO TO CITATION(S) 3201008499, 8504, 8675, 8702, 8707, 9056

8725 **(AD-A—144684/8) Evaluation of microcomputer energy analysis programs. Final report.** Lawrie, L.K.; Klock, W.; Leverenz, D. (Army Construction Engineering Research Lab., Champaign, IL (USA)). Jul 1984. 49p. (CERL-TR-E—193). NTIS, PC A03/MF A01.

The evaluation was performed by comparing building simulations provided by micro programs to those provided by the Building Loads Analysis and System Thermodynamics (BLAST) program. The two micro programs chosen for evaluation (OPCOST and SASEAP) are representative of the type of bin method calculations used in simplified energy analysis procedures. The evaluation was based on four factors: (1) the ability of the programs to calculate overall annual building energy consumption, (2) their ability to study design options for developing energy-efficient new construction, (3) their ability to calculate energy savings from various building retrofit options, and (4) the amount of input information required which would be considered judgemental in nature as opposed to building description oriented. The results of the evaluation showed that the microcomputer energy analysis programs could reasonably predict the proper ranking of design alternatives or retrofit options. However, the programs could not accurately predict total annual energy consumption. Thus, the micro programs should not be used to determine compliance with energy budgets. Likewise, the micro programs could not predict the actual energy savings due to a design alternative or a retrofit option. The results did not clearly illustrate which design options were modeled accurately.

8726 **(AD-A—145395/0) Brightness comparison of electroluminescent versus incandescent lighting: a photometric validation. Final report.** Perry, M.D. (Aerospace Medical Research Lab. (6570th), Wright-Patterson AFB, OH (USA)). Jun 1984. 32p. NTIS, PC A03/MF A01.

Previous studies involving the brightness comparison of electroluminescent (EL) versus incandescent (INC) lighting indicated that observers saw the EL light as being 'brighter' than the INC light even when both lights were photometrically identical. The intent of this experiment was to determine if a perceptual process was present that inhibited the direct photometric measurement of EL lighting. Twelve observers were asked to compare a variable EL light with a fixed INC light. Nine different brightness levels of the EL light were tested. Subjects were asked to rate if the test lamp (EL) was higher, lower, or the same as the reference lamp (INC). The results from this study showed no difference between the two types of lighting; this in turn validates the use of photometry to measure EL lighting directly.

8727 **(AD-A—145530/2) Summary of USA-CERL research on control of heating, ventilating, and air-conditioning systems. Final report.** Hittle, D.C.; Johnson, D.L. (Army Construction Engineering Research Lab., Champaign, IL (USA)). Jul 1984. 20p. (CERL-SR-E—197). NTIS, PC A02/MF A01.

This report summarizes research conducted to date by the U.S. Army Construction Engineering Research Laboratory (USA-CERL) to devise new technologies for improving heating, ventilating, and air-conditioning (HVAC) controls. As new technologies are developed, they will be disseminated not only through the usual mechanisms (i.e., Army Corps of Engineers, and USA-CERL publications), but also through users groups, in which potential recipients will have a chance to ensure that the products are responsive to their needs. The research will be done in three main areas: (1) component evaluation, (2) control loop implementation, and (3) system application. The objective will be to develop control systems, especially for retrofit applications, that are simple, efficient, reliable maintainable, and well-documented. Conclusions of research done so far indicate that: (1) Many HVAC systems are not performing as designed; (2) In some applications, pneumatic temperature control equipment is not accurate enough; (3) Pneumatic actuators should be retained, when possible; (4) Thermistor temperature detectors are not appropriate for HVAC applications; (5) Humidity sensors are prone to drift and hard to calibrate in the field; (6) Proportional plus integral control schemes, coupled with accurate sensing and control, can significantly reduce operating costs; (7) The prototype retrofit control panel developed by USA-CERL should provide both reliability and cost savings.

8728 **(ANL/CNSV-TM—145) Assessment of residential energy conservation programs.** Kier, P.H.; Ettinger, G.A.; Hrabak, R.A.; Kron, N.F. Jr.; Suchy, K.W.; Tschanz, J.F.; Von Zuckerstein, I.M. (Argonne National Lab., IL (USA)). May 1984. Contract W-31-109-ENG-38. 173p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85004682.

This report provides a broad overview of programs that encourage residential energy conservation or provide services that result in energy conservation in residential space heating, space cooling, and water heating. These programs focus on residential buildings with one to four dwelling units. Energy conservation retrofits are a type of discretionary home improvement that may be a good investment but that still must be subordinate to the purchase of necessities and must compete with other discretionary purchases. Hence, the attitudes, motivation, and information needs of energy consumers are important considerations that should be accounted for in promoting and structuring a program of residential energy conservation. A literature review identifies the relevant characteristics of consumers and how the consumers interact with the programs. An inventory containing short descriptions of programs is included, but is not meant to be exhaustive; rather, it illustrates the wide variety of programs currently or formerly in operation. The inventory also mentions the many organizations that sponsor or cooperate in programs and the variety of techniques that are used. Based on a qualitative assessment of these programs and the information obtained from the literature review, five hypotheses were

developed about characteristics that tend to be associated with successful programs.

8729 **(BFR-R—116-1983) Individual and flexible adaptation of temperature in spaces and buildings with small energy requirements. Measurement and evaluation of an office building at Arboga.** Jansson, S.; Oskarsson, L.G.; Soedergren, D. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1983. 120p. (In Swedish). NTIS (US Sales Only), PC A06/MF A01. File Number TI85750443.

The energy consumption of an office building and subsequent steps of energy conservation are described. The original consumption of the building having an area of 1750 m^2 was 69 kWh per m^2 and year. This consumption was reduced by 16% when applying the following steps. The temperature has been lowered and the air flow has been reduced by night and during holidays. The necessary control was made by a microcomputer system.

8730 **(CONF-840414—3) M.A.N. heat pumps in industry and local authorities.** Griesbach, G. (Maschinenfabrik Augsburg-Nuernberg (M.A.N.) A.G., Muenchen (Germany, F.R.). Bereich Neue Technologie). 1984. 22p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number TI85770039.

From 1984 Hanover fair; Hanover, F.R. Germany (4 Apr 1984).

With heat pumps, a distinction should be made between two groups with different annual operating times. The first group covers heat pumps for heating; with this type, use of the thermal output has priority and the heat source used is in most cases heat from the environment. The second group contains heat pumps for the industrial and commercial sector which in many cases are used for heat recovery; with these heat pumps the cold output as useful energy is the main consideration. In the course of this lecture three examples of heat pump systems will be presented - simultaneous use of heat and cold in an industrial plant and a heating system for a school and a hospital.

8731 **(DOE/ID/12222—T2) Assessment, development and coordination of technology base studies in enhanced heat transfer. Final report.** Bergles, A.E.; Nelson, R.M.; Junkhan, G.H.; Webb, R.L. (Iowa State Univ. of Science and Technology, Ames (USA). Engineering Research Inst.). Mar 1984. Contract FG07-81ID12222. 150p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85004130.

Five tasks were undertaken to advance the understanding and utilization of heat transfer enhancement techniques in commercial heat exchange equipment. Accomplishments in the five task areas are as follows: The technology information base was expanded by increasing the documentation of papers and reports from 1967 to 3045 entries. The US Patent citations were increased from 321 to 454. Bibliographic reports of these two citation data bases have been issued. The third data base consists of a listing of manufacturers and their products related to enhanced heat transfer technology. The present compilation of 221 entries, which updates and expands the previous list of 185 companies, is presented. A complete list of possible thermal-hydraulic performance evaluation criteria for single-phase enhancement has been developed. Entropy generation has been added to the usual list of constraints and objectives. A computer study narrowed the possible criteria from 237 to 86. Three of the 86 are provisionally recommended as useful criteria for design. A data base was established for single-phase heat transfer and friction performance of spirally fluted (helical repeated rib) tubes. A study was undertaken to clarify the performance and the enhancement mechanism of the commercial T-fin GEWA-T tube. A study of horizontal falling film evaporation on horizontal tubes with smooth and structured surfaces was completed.

8732 **(EIR—528) Exhaust measurements in stationary gas engines of cogeneration units and heat pumps.** Koebel, M. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Aug 1984. 62p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE85750701.

Exhaust measurements were carried out in six stationary gas engines. Of these, five were spark ignition engines and one a gas ignition jet engine. Four engines served as heat pump drives, two as cogeneration unit drives. The measurements proved the high specific emissions of internal combustion engines, especially in the field of nitric oxides. The values are in the range between 1000 and 2000 g NO_2/GJ of end use energy. In contrast, the emissions of a conventional gas boiler amount to only 35 g NO_2/GJ of end use energy. These figures show that measures to reduce NOsub(x) emissions will be indispensable with the more widespread use of these engines. Otherwise, air pollution due to heat and power generation will increase. The specific emissions of CO and hydrocarbons, too, are several times higher than in conventional heating boilers.

8733 **(LBL—18683) Experimental methodology for determining the system performance of fluorescent lamp, ballast, fixture combinations operating under realistic application conditions.** Siminovitch, M.J.; Rubinstein, F.M.; Verderber, R.R. (Lawrence Berkeley Lab., CA (USA)). Nov 1984. Contract AC03-76SF00098. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004446.

To meet the need for accurate performance data, an experimental method for determining the performance of lamp, ballast, and luminaire combinations operating under a broad range of realistic conditions was developed. The methodology employs a two-part experimental procedure. The first part uses a temperature-controlled luminous flux integrator to characterize the thermal performance of each lamp/ballast combination. This performance characterization is expressed in terms of light output and efficacy as a function of variations in minimum lamp wall temperature (MLWT) and is generated for the range of temperatures typically encountered in interior lighting applications. The second procedure uses a luminaire/plenum simulator to determine the specific MLWT that exists in a particular luminaire application as a function of luminaire type, mounting configuration, plenum integration, and room air temperature. The MLWTs thus measured may be used in conjunction with the lamp/ballast performance data to determine application-specific values of light output and efficacy for a given lamp/ballast/luminaire system.

8734 **(NP—5750392) Additional insulation of flat roofs. Final report.** Korsgaard, V.; Christensen, G.; Lohse, U.; Prebensen, K.; Brandt, J. (Cowiconsult Raadgivende Ingenioerer A/S, Virum (Denmark)). Dec 1981. 125p. (In Danish). NTIS (US Sales Only), PC A06/MF A01. File Number TI85750392.

In 1977 the roof problem in 2,100 L-shaped atrium houses in Albertslund, near Copenhagen, had reached such an extent that thorough intervention was necessary. The actual testing programme comprised 56 atrium houses. In addition two houses with corrugated asbestos cement on roof trusses as well as two two-storey row houses (without additional insulation) have been included in the project. In Albertslund the roof slope was altered from 1:100 to at least 1:50 in row houses and to 1:25 in the L-shaped garden houses in the final renovation, and integral gutters at fascia boards were replaced by external gutters. If additional insulation is applied on top of the existing roofing felt - which then acts as a new and more secure vapour barrier - the heat transmission through the roof, and consequently the energy consumption, will be reduced. Test programme consists in measuring temperature and moisture content in the roof deck (plywood) at different thicknesses of insulation, with and without ventilation of the cavity over the insulation in the existing roof components. Moisture content and fungal attack and temperature measurements were made by placing in the plywood deck a "measuring disc-gauge", in at least five measuring points. External additional insulation to a flat, ventilated roof constructed of wood-based materials has two advantages: The thermal insulation is improved and considerable energy saved, the protection against absorption of moisture is improved. Ventilation of the orginal roof cavity and water drainage from it should be provided.

8735 **(NP—5750393) Measurements of fuel-oil consumption in greenhouse nursery boilers.** Rasmussen, H.C.; Landorph, D.L. (Odense Univ. (Denmark). Lab. for Energiforskning). 1983. 85p. (In Danish). NTIS (US Sales Only), PC A05/MF A01. File Number TI85750393.

The different methods to measure fuel oil energy consumption in boilers in the power range up to 6MW is reviewed followed by an analysis of the commercial available instruments on the Danish market. Further a note on calibration is given.

8736 **(NP—5750399) Measurements of heat consumption in specially insulated buildings.** Korsgaard, V.; Bunch, T.; Brandt, J. (Cowiconsult Raadgivende Ingenioerer A/S, Virum (Denmark)). Jan 1982. 43p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. File Number TI85750399.

Heat consumption in comparable insulated houses varies about +- 20%. Measurements of individual apartment consumption encourage energy-saving opposite to collective metering. An exaggerated heat economy can result in moisture in insulated apartments, heat meters should have an initial threshold of heat consumption as the lowest limit.

8737 **(NP—5750400) Preliminary investigation of small heat pumps.** Jantzen, O. (Jydsk Teknologisk Institut, Aarhus (Denmark)). Dec 1982. 17p. (In Danish). NTIS (US Sales Only), PC A02. File Number TI85750400.

The purpose of this project is to evaluate the use and operation of small heat pumps for water heating. A list of the commercially available heat pumps with some technical data is given.

8738 **(NP—5750409) Effect of jointing work performed as an energy-saving measure.** Brandt, A. (Jydsk Teknologisk Institut, Aarhus (Denmark)). Dec 1983. 50p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. File Number TI85750409.

In order to establish the effect of replacing mortar joints by plastic or elastic sealants, an investigation of a number of multistory buildings has been carried out within the framework of the Danish Energy Research Programme EFP-81. An actual heat-saving effect could be established only in a few cases after replacement of windows and joints. The condition of the sealants was good after a few years of practical exposure. A surface cracking wich was not found to have any significant importance to the life of the joints was noted. The adhesion was good to tiles, wood and PVC. It was not possible to establish any decomposition of wooden windows owing to formation of condensate behind the tight seaplants placed at the outside, i.e. as a one-stage joint. It must be underlined that the investigation has only comprised brick built buildings.

8739 **(NP—5750417) Individual settling of heat account in apartment buildings with common heat supply.** (Statens Byggeforskningsinstitut, Hoersholm (Denmark)). Dec 1982. 72p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. File Number TI85750417.

Heat meters as the basis for heat account settling in apartment buildings have to be reliable and precise. New electronic equipment and new pricing based on heat consumption is badly needed, as well as systematic control of heat meters several times a year.

8740 **(NP—5750418) Heat recovery from stables, 4.** Takai, H.; Pedersen, S. (Statens Jordbrugstekniske Forsoeg, Horsens (Denmark)). Sep 1982. 25p. (In Danish). NTIS (US Sales Only), PC A02/MF A01. File Number TI85750418.

A description is given of the different types of stable heat pumps that are used in practice, and a survey is given of the efficiency factors that were measured on 17 heat pumps during 1979 to 1982. Results from a questionnaire investigation on operational experiences are also given.

8741 **(NP—5750419) Heat recovery from stables, 5.** Johansen, P.; Takai, H. (Statens Jordbrugstekniske Forsoeg, Horsens (Denmark)). Oct 1983. 20p. (In Danish). NTIS (US Sales Only), PC A02/MF A01. File Number TI85750419.

A description is given of the heat recovery systems of 20 stable heat pumps and their operation. The investigation shows that the heat pumps have become more reliable in operation, though some improvements have to be made to obtain the same reliable operation of a heat pump as the more traditional heating systems. The total effect factor was in average for the 20 stable heat pumps 2,5.

8742 **(NP—5750439) Energy conservation. The energy saving potential of the buildings of the country.** (Norges Teknisk-Naturvitenskapelige Forskningsraad, Oslo). Feb 1983. 37p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. File Number TI85750439.

The total mass of buildings in 1980 is about 230 mill.m^2 with 60% as housing and 40% as business buildings. By the year 2000 housing is expected to increase by approximately 25% and business buildings by about 20%. The energy needed for operating these buildings in 1980 was about 61 TWh, approximately 5 TWh may be saved by exclusively using electric heating. Field studies show that energy conservation measures often do not produce the expected effect. Heat and ventilation measures often give a greater economizing effect than calculated earlier. Much energy can be saved by a better monioring of the operation and regulation routines. A substantial part of the conservation effect is obtained by measures on the existing buildings. The total energy conservation potential by the year 2000 is calculated to be 10 - 16 TWh or about 4000 mill.NOK by an electric power price of 0.3 NOK/kWh. 4 drawings, 16 tables.

8743 **(NP—5770029) Fuel consumption in Bavarian residential farm buildings and possible methods for meeting heat requirements by means of straw and wood.** Heins, F. (Technische Univ. Muenchen, Freising (Germany, F.R.). Fakultaet fuer Landwirtschaft und Gartenbau). 9 May 1983. 161p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number TI85770029.

The 1980/81 fuel expenditures in agriculture (including domestic purposes) amounted to ca. 29.5% of expenditures for energy and, thus, were on the same level as the proportion of electricity relative to total energy consumption. Fuel consumption of Bavarian farming entreprises is studied in greater detail, with a special demonstration of the effect of important characteristics on fuel consumption. Beyond this, there is an assessment of the potential of wood wastes and straw and of their possible contribution to energy supply within agriculture.

8744 **(NP—5770067) Contribution to the determination of transverse movement of the piston in high speed internal combustion engines.** Brucker, E. (Stuttgart Univ. (Germany, F.R.). Fakultaet 5 - Energietechnik). 10 May 1982. 171p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number TI85770067.

The continuous increase in output which can be noted in supercharged diesel engines leads to ever-increasing mechanical and thermal stresses on the piston. In order to solve the resulting strength problems and to investigate the secondary movement of the pistons, which is largely responsible for the production of mechanical noise, it is necessary to transmit measurements from the piston to the outside while the engine is running. A measurement transmission system was designed and optimized for this purpose, which has no effect on the secondary movement of the piston to be measured. Using this transmission system, measurements of the secondary movement of 3 pistons with different offsets of the piston bolt were made in differential and single circuits. The effects of different piston and operating parameters were determined. Details of the secondary movement, particularly the impact speed and therefore the pulse of the piston when hitting the cylinder wall in the region of ZOT are given. Structural measures to reduce the amount of noise could be derived from the different characteristics of impact force on both edges of the piston.

8745 **(PB—84-218288) Mitsubishi Denki Giho, Volume 58, Number 5, 1984.** (Mitsubishi Electric Corp., Tokyo (Japan)). 1984. 79p. (In Japanese). NTIS, PC E05/MF E01.

See also PB84-218296 and PB84-198720. Summaries in English.

This issue contains research reports on energy saving devices such as: The Development of a Gas-Engine-Driven Heat Pump; An Air-to-Water Heat-Pump Unit with a New Refrigerant; A Cold-Storage Management System; Type BCU Super-Low-Temperature Brine Chillers; A wide-Range, Highly Efficient Refrigerating-Cycle Control System; Multi-Split-Type Packaged Air Conditioners; The Type PFC Packaged Air Conditioner for Use in Clean Rooms;

Combination Q: A Cooling, Heating, and Hot-Water Heat-Pump Unit; A radar Rain-Guage System; A Vibration-Control System Using an Active-Mass Damper; A Highly Efficient Scroll Compressor.

8746 **(PB—84-232370) Modelling the daylight levels produced in rectangular, side-lit rooms by vertical windows containing clear or body-tinted glazing.** Sharples, S.; Page, J.K.; Souster, C.G. (Sheffield Univ. (UK). Dept. of Building Science). Dec 1981. 45p. (BS—62). NTIS, PC E04/MF E04.

The increasing importance of daylight as a means of reducing the overall energy consumption within a building is discussed. The conflict between statutory limits on percentage area glazing and the possible increased use of artificial lighting is also considered. The basic theory of natural daylighting in buildings is described, together with the various sky luminance distribution types available for quantifying internal daylight levels. The mathematical theory of a new daylight computer model developed within the Department of Building Science is given. This new model enables daylight levels to be determined rapidly for small windows in relatively thick walls, for windows of varying KL value and for obstructed sky views. A comparison is made of the present daylight model with other existing computer programs and the results from a scale model under an artificial sky. Finally, a description of how to use the new daylight model is presented and an example of a typical run using the model produced.

8747 **(PB—84-233998) Theoretical and experimental study of the environmental performance of a low cost starter home.** Ward, I.C.; Sharples, S. (Sheffield Univ. (UK). Dept. of Building Science). Aug 1982. 40p. (BS—67). NTIS, PC E04/MF E04.

This report describes the results of a theoretical and experimental study of the internal environmental performance of a low-cost starter home carried out by the Department of Building Science. Details of the computer facilities available within the department are given, together with the equipment used for making model and full-scale measurements. The starter home examined in this study is found to have satisfactory thermal, condensation and daylighting characteristics but ventilation results suggest that its infiltration heat losses could be reduced significantly by greater attention being paid to sealing fabric and structural joints.

8748 **(SBI-R—154) Building-survey as the basis for energy management in larger buildings.** Dinesen, J.; Moerk, P. (Statens Byggeforskningsinstitut, Hoersholm (Denmark)). 1983. 99p. (In Danish). NTIS (US Sales Only), PC A05/MF A01. File Number TI85750387.

SBI report 154 is to be used as basis for the planning and carrying out of a detailed survey of a building and describes the chief aim and function of a building survey in the running energy control. In the introduction an account is given of the connection between the present report and SBI report 117, which describes "A system that ensures energy-saving operation", i.e. a system that ensures running energy control. The detailed building survey has two main objects. It supplies data for the calculation of the theoretical energy consumption of the building, and it forms the basis for the preparation of a list of energy saving measures in order of priority. Calculation of energy consumption and determination of the order of priority of energy-saving measures are described. The report has three appendices: the whole set of tables for the building survey, calculations of the energy consumption of the building, and a check list for the periodical checking of functions.

8749 **(TNVP—81-03) Instruction on testing of heat meters.** (Danske Elvaerkers Forenings Udredningsafdeling (DEFU), Lyngby). Jul 1981. 11p. (In Danish). NTIS (US Sales Only), PC A02/MF A01. File Number TI85750422.

A presentation is given of testing procedures of heat meters for heat pumps. The testing concerns only the electronic equipment of the meters.

8750 **Counterflow absorber for an absorption refrigeration system.** Reimann, R.C. (to Dept. of Energy). US Patent 4,467,623. 28 Aug 1984. Filed date 6 Jan 1983. vp. PAT-APPL-456132.

An air-cooled, vertical tube absorber for an absorption refrigeration system is disclosed. Strong absorbent solution is supplied to the top of the absorber and refrigerant vapor is supplied to the bottom of the absorber to create a direct counterflow of refrigerant vapor and absorbent solution in the absorber. The refrigeration system is designed so that the volume flow rate of refrigerant vapor in the tubes of the absorber is sufficient to create a substantially direct counterflow along the entire length of each tube in the absorber. This provides several advantages for the absorber such as higher efficiency and improved heat transfer characteristics, and allows improved purging of non-condensibles from the absorber.

8751 **Evaluation of utility residential energy conservation programs: A Pacific Northwest example.** Hirst, E.; Bronfman, B.; Goeltz, R.; Keating, K.; Lerman, D.; Timble, J. (Oak Ridge National Laboratory, Oak Ridge, TN). *Energy (Oxford);* **9**: No. 3, 193-206(Mar 1984).

This paper describes a detailed quantitative evaluation of the Residential Weatherization Pilot Program, operated by the Bonneville Power Administration from 1980 through 1982. The program provided free energy audits to more than 6000 electrically-heated homes and gave zero-interest loans to weatherize almost 4000 of these audited homes. The total cost of the program was almost $8 million. Using actual electricity consumption records for program participants and nonparticipants, we calculated the energy-saving effect of the pilot program in several ways and always reached the same conclusion. Households that received an audit and weatherization loan reduced their annual electricity consumption by about 3500 kWh relative to what they would have done without the program; this 3500 kWh is the saving that can be directly attributed to the program. Using a simple net present worth approach, the authors computed program benefits and costs for participating households, the BPA power system, and the Pacific Northwest region as a whole. Under a wide range of assumptions concerning discount rate, years until the weatherization loan is repaid, program energy saving, and BPA's marginal cost of power, the program is economically attractive from all three perspectives.

8752 **Simplified energy analysis methodology for commercial buildings.** Turiel, I.; Boschen, R.; Levine, M.; Seedall, M. (Lawrence Berkeley Laboratory, Energy Analysis Program, University of California, Berkeley, CA). *Energy and Buildings;* **6**: No. 1, 67-83(Jan 1984).

Commercial building energy analyses may be used for new building design, energy end use forecasting and energy audit calculations. Many building simulation programs, such as DOE 2.1A or BLAST, are quite complex and must be run by specialists on main frame computers. A simplified method of commercial building energy analysis has been developed that utilizes a database of previous DOE 2.1A simulations to predict the outcome of other simulations. The authors have applied this methodology to an office building in one climate region and it predicts heating, cooling, and total energy use very accurately. The main advantage of this methodology is that less specialized skill is required and only a microcomputer is needed to perform the analyses. Therefore, energy analyses can be done cheaply and quickly.

8753 **ORNL guest facility design and data results.** Shapira, H.; Christian, J. (Oak Ridge National Laboratory, Oak Ridge, TN). pp 33-34 of Shaping our energy future. Knoxville, TN, USA; LTM Consultants (1984). (CONF-840229—).

From 11. annual WATTec conference and exposition - shaping our energy future; Knoxville, TN, USA (21 Feb 1984).

Abstract only.

A 372 m^2 (4000 ft^2) office/dormitory structure has been designed and constructed for the Holifield Heavy Ion Research Facility at the Oak Ridge National Laboratory. The structure is earth-sheltered on the north side and portions of the west and east walls. The earth cover on the roof ranges from 46 to 76 cm(1.5 to 2.5 ft). Direct gain space heating as well as combination direct-gain/Trombe wall space heating are incorporated in the high mass structure. Window management includes reflective insulating blind units which in winter operate on nighttime mode as window insulating shutters and in daytime mode as reflectors of direct solar radiation

to the ceiling. Beside the space heating contribution, a deeper penetration of lighting results, without material fading, furniture obstruction or glare. Additional seasonal direct-gain control is provided by an extended overhang. The building is heavily instrumented (roughly 100 sensors surround the building) and thermal performance data has been gathered for the past two years. The presentation will focus on both design and thermal performance of the structure which is verified by the collected data.

8754 **Climatic design: energy-efficient building principles and practices.** Watson, D.; Labs, K. New York, NY, USA; McGraw-Hill Book Company (1983). 280p.

The scientific principles and practical application of designing a building to suit its local climate are described. A technical discussion is presented of the theory of climate design including: conduction, convection, radiation and evaporation. An illustrated catalog of 50 climate design techniques are described, each of which fulfills one of the following concepts of climatic design: wind breaks, plants and water, indoor/outdoor rooms, earth sheltering, solar walls and windows, thermal envelope, sunshading, and natural ventilation. This book provides the designer with factural data about climate and shows how to accurately document climatic design criteria. A complete bibliography of reference in climatic design is included.

8755 **(BG-Trans—5808) Heat pump: theoretical principles and gas space heating possibilities.** Schuster, F. Translated from *Gas, Wasser, Waerme ;* **34**: No. 6, 193-196(1980). 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85900249. DE85900249

The predictions for the practical application of both types of heat pump in the 1952 report derived from theoretical scientific principles reproduced in this article have been confirmed in every respect by the compression systems installed over recent years and the development of suitable absorption systems, specially gas-heated systems.

3202 Transportation

REFER ALSO TO CITATION(S) 3202008767, 8789

8756 **(CONF-8306245—1) Aerodynamical development of research- and serially produced vehicles shown with the research passenger car and the compact car class of Daimler-Benz.** Hack, A. (Daimler-Benz A.G., Sindelfingen (Germany, F.R.)). 1983. 54p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number TI85770072.

From Seminar on motor vehicles 1983; Karlsruhe, F.R. Germany (9 Jun 1983).

A brief introduction on the increased importance of aerodynamics in vehicle construction is followed by an explanation on the influence of aerodynamics on fuel consumption (characteristic diagrams and tables provided) and the resulting importance for the economy of cars. Further tasks (substitution of steel materials by the lighter aluminium, reduction of air resistance) and working methods (draft optimation by computers, wind tunnel measurement) are briefly dealt with. A large chapter is dedicated to target conflicts during aerodynamic developments. Illustrated by various pictures of cars the development of a research passenger car and of a new car of the type 190 is explained with regard to the aerodynamic point of view. Details on the suitable form design of individual car parts such as fenders, windscreen, rear end, front end, plastic covers underneath the engine compartment (air flows), hood. Hints are given on the weight reduction caused by the front axle drive. A comparative evaluation and a look into the future round off the lecture.

8757 **(NP—5750402) Analysis concerning regenerative braking of a regional train (Danish State Railways). Final report.** (Krarup (N.), Copenhagen (Denmark)). Nov 1983. 41p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. File Number TI85750402.

About 50% of the total energy supplied by the train engine is lost in form of heat due to braking. Regenerative braking recently used in hybride bus seems to be the obvious solution for energy saving. Computerized simulation of regenerative braking proves that considerable fuel economy with use of an adequate energy storage unit is obtained. Another possible source of fuel economy is a more flexible timetable with optimized train velocities.

8758 **(NP—5770005) Analysis of cis-lunar transportation system with nonconventional rocket engines under particular consideration of the life-cycle cost.** Thomas, U. (Technische Univ. Berlin (Germany, F.R.). Fachbereich Verkehrswesen). 3 Feb 1984. 243p. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number TI85770005.

A comprehensive analysis of chemical engines using liquid oxygen and aluminium powder, solid core nuclear engines, nuclear light bulb engines and ion engines for cis-lunar space application was carried out. The markets envisaged are the nuclear waste disposal on the lunar surface and the support of solar power satellite construction in geostationary orbit. It is shown that the most fuel efficient permanent space transportation system is not neccessarily the most economical choice. None of the investigated propulsion systems offers lower specific transportation costs compared with LOX/LH_2 engines on all routes. Only solid core reactors have a chance to be more economical between low earth orbit and lunar orbit than chemical propulsion systems of the SSME variety. Therefore no major breakthroughs in rocket engine technology are required for the development of economical cis-lunar space transportation systems.

8759 **(PNL—5183) Examination of the feasibility for demonstration and use of radioluminescent lights for Alaskan remote runway lighting. Final report.** Jensen, G.; Perrigo, L.; Leonard, L.; Hegdal, L. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1984. Contract AC06-76RL01830. 237p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE85002503.

Radioluminescent (RL) lights have been used with some success as illuminators to assist night landings of aircraft. This application has been identified as a potentially valuable alternative to fireports or similar nonconventional lighting at many rural airports throughout Alaska. RL airport illuminators are experimental at this time and are not available commercially; however, successful demonstrations have been made suggesting that a prototype design has been refined to a point where technology transfer to industry may be made in the near future. Preliminary cost estimates suggest that significant cost advantages could be possible for applications in rural Alaska compared to conventional lighting systems. Since the RL lights contain radioactive materials, there is some potential risk that their use will result in exposure to radiation doses to humans who come into contact with them. Under normal usage, this risk is shown to be insignificant. Under worst-case accident scenarios, however, it is possible that a significant dose greater than 5.0 rem could be received by a limited number of people.

3203 Industry And Agriculture

REFER ALSO TO CITATION(S) 3203008189, 8281, 8447, 8449, 8455, 8456, 8681, 8731, 8740, 8741, 8877

8760 **(AD-A—144466/0) Investigation of power factor controller applications. Final report.** Chionis, M.B.; Sliwinski, B.J. (Army Construction Engineering Research Lab., Champaign, IL (USA)). Jul 1984. 68p. (CERL-TR-E—196). NTIS, PC A04/MF A01.

This study was conducted to evaluate the power factor controller (PFC) as a potential energy conservation device for Army applications and to develop guidelines for its use. An examination of studies conducted on the PFC showed that it can be an effective energy conservation device when properly applied, cutting motor energy consumption by at least 10 percent on low-efficiency motors. However, the use of high efficiency motors is almost always more energy conservative, and PFCs do not improve the performance of motors whose efficiency is already high over the load range.

8761 **(CONF-840414—5) Production of compressed air with waste heat recovery in industrial plants.** Nolting, E. (Maschinenfabrik Augsburg-Nuernberg (M.A.N.) A.G., Muenchen (Germany, F.R.). Bereich Neue Technologie). 1984. 14p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number TI85770041.

From 1984 Hanover fair; Hanover, F.R. Germany (4 Apr 1984).

Industrial plant as well as public utilities have always attached great importance to high utilisation of primary energy. Proof of this is given by the many cogeneration power stations for central electricity and heat supply in Germany. Particularly noteworthy in this context are the cogeneration plants with small internal combustion engines, of which about 200 plants have now been installed in Germany. Another typical representative of cogeneration technology is the heat pump. Here the public utilities have made particular efforts by investing in heat pumps for space heating. The primary energy savings achieved by these cogeneration technologies lie between 30 and 60%. These savings usually result in an amortisation period of about 5 years for cogeneration plants. Since this amortisation period is relatively long when compared with other industrial investments, only a few cogeneration plants have been realised in the industrial sector. Compressed air is an important energy medium in German industry. From breweries through to foundries, compressed air is needed in almost every German industrial plant.

8762 **(CONF-840414—6) Increasing the power/heat ratio in industrial power stations; matching cogeneration to a new consumption structure.** Richter, D. (Maschinenfabrik Augsburg-Nuernberg (M.A.N.) A.G., Augsburg (Germany, F.R.)). 1984. 25p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number TI85770055.

From 1984 Hanover fair; Hanover, F.R. Germany (4 Apr 1984).

In the face of the fuel crises, operators have adopted a policy of cutting down on process heat which appears to make economical sense. However, where this involves a reduction of inhouse power generation in a cogeneration scheme the operator is likely to find himself on the horns of a dilemma. He will be faced with a higher bill for purchased power and his existing cogeneration plant will no longer match relative heat and power loads. Moreover, savings in heat are frequently bought at the cost of an increased power load. Apart from power plant operating measures, such as carnotization, there are today medium-speed piston engines running on natural gas, heavy oil or light oil and capable of reliable continuous operation which - tied thermally into the steam circuit - considerably increase the power/heat ratio of the plant and match it to the new consumption structure.

8763 (CONF-8404199—, pp vp) **Waste utilization method through gasification and combustion.** Wandrasz, J. 1984. (In German). NTIS (US Sales Only), MF A01. File Number TI85770037.

From 4. colloquium on waste management; Saarbruecken, F.R. Germany (26 Apr 1984).

The paper presents an operating industrial plant for the combustion of liquid toxic substances contained in plastics and wastes. Gasification is performed in a shaft furnace co-operating with a cyclone chamber. In this chamber, the forming gas is combusted together with the other liquid waste materials at a temperature of above 1,273 K. A fluidized-bed chamber co-operates with the cyclone chamber and is used as a low temperature compensator. The whole plant features an energy recuperation system and an equipment for neutralizing toxic gaseous products.

8764 (CONF-8404199—, pp vp) **Special-waste disposal in the Federal State of Hesse, experience and results gained with the operation of the waste-water-free flue gas treatment facility at the Biebesheim special-waste combustion plant.** Erbach, G. 1984. (In German). NTIS (US Sales Only), MF A01. File Number TI85770037.

From 4. colloquium on waste management; Saarbruecken, F.R. Germany (26 Apr 1984).

Thermal treatment of organic special wastes comprises the combustion and elimination of pollutants such as chlorine, sulphur and fluorine, and of aerosols and heavy metals. The plant is equipped with a waste-water-free fluegas treatment plant which removes pollutants from the fluegas.

8765 **(NP—5750389) Development of a gas-heated singeing oven for swine slaughterhouses.** Laursen, A.; Thorsen, O. (Slagteriernes Forskningsinstitut, Roskilde (Denmark)). May 1984. 26p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. File Number TI85750389.

The possibilities of singeing pig carcasses in ovens heated by natural gas were investigated. The singeing tests were carried out at the NV Bacon Factory in Slagelse, Denmark, where one of the two oil-heated singeing ovens was converted to gas firing. At a slaughter speed of 240 pigs/h the gas consumption of the pilot plant will correspond to an energy content of 0.76 litre motor gas fuel per carcass. The value is valid for a degree of singeing which is effective enough for bacon production. This energy consumption is higher than for oil-heated singeing. A minor part of the surplus consumption is consumed by the improvement of the singeing quality achieved, but the majority is transported with the waste gas to the chimney. It should, however, be taken into account that intensive work on oil-heated singeing has almost halved the fuel consumption during the last five years. Even though many of these saving measures were used, too, in this gas-heated singeing oven, it might be possible with a similar work to decrease the gas consumption. At Slagelse an effect of 1633 kW was used with gas firing in the singeing oven, as opposed to the 1216 kW used with fuel-heating, which corresponds to an extra effect of 417 kW or 1.7 kW/pig carcass in gas singeing. Measuring results also show that a majority of the surplus energy used in gas singeing is still present in the waste gas after the carcasses have been singed, and the the heating surface of the heat recovery system which is already installed must be increased if this larger amount of energy is to be utilized. If the heating surface of the heat recovery system at Slagelse were increased and the waste gas through the system could be cooled down to about the same temperature level as the one measured in fuel-heating, the effect consumption by gas- singeing would be 146 kW larger than in fuel-singeing corresponding to a surplus consumption of 0.6 kW/carcass.

8766 **(NP—5750415) Dynamic test rig for air/water heat pumps.** Olsen, T. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Koeleteknik). Mar 1984. 73p. (In Danish). Danmarks Tekniske Hoejskole, Laboratory for Koeleteknik, Lyngby. File Number TI85750415.

In this project, a test rig, capable of testing air/water heat pumps operating both in steady state and dynamic mode, has been designed. During the dynamic tests the variations in temperatures on the hot side of the heat pump have been similar to those observed when the heat pump is operating in a house. A method of reducing the large amount of data related to dynamic tests is presented. Quantities, which are to be considered characteristic in the dynamic mode, are proposed. Further the term Dynamic Losses is defined. First a number of tests under steady state conditions were carried out in order to study the performance of the heat pump operating under those conditions. Also a number of tests have been carried out on the test rig in order to study the dynamic performance of a heat pump exposed to varying load conditions. It has been found that the dynamic losses increase as the load decreases. The importance of proper heat pump sizing is demonstrated. In particular, oversizing is to be avoided. Finally, a number of subjects, to which one could apply the results obtained in the project, are pointed out. For example it is possible to make more precise computer simulations of heating systems including air/water heat pumps, if the results of a dynamic test of the heat pump are available. By applying the described method, it is possible to test heat pumps already installed in houses, where it is rather impossible to establish the conditions needed to make steady state tests.

8767 **(NP—5750416) Conversion of heat from diesel engine flue gas into mechanical power. Project OLIEFISK.** (Jydsk Teknologisk Institut, Aarhus (Denmark)). 1984. 49p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. File Number TI85750416.

This project is a section of the OLIEFISK PROJECT concerning utilization of waste heat from the main diesel engines of the

ship. As the model a Caterpillar engine type 398 (V-12) with turbocharge was chosen as the most used on North Sea fishing vessels. Utilization of flue gas heat was investigated in following processes: Direct conversion of thermal energy into electric power, gas turbines, Rankine process with water steam or refrigerant/generator operation, Stirling engine/generator operation. Evaluation of these processes and benefits for ship economy are described.

8768 **(NP—5750426) Energy conservation measures in horticultural greenhouses. Economic assessment.** Fog, M.M. (Statens Jordbrugsoekonomiske Inst., Valby (Denmark)). 1984. 58p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. File Number TI85750426.

Temporary investigations of the energy consumption in greenhouses prove, that the consumption can be estimated by a P-value (energy loss per m^3 and degree) primarily based on the construction of the house. The investigations have also shown, that the energy consumption in the greenhouses is only part of the total energy consumption on the holding. Th residue, the basic energy consumption, is loss during transport of energy from the central heating center to the greenhouses, and heat requirement in growrooms and packingrooms etc. A model for decision making of investments concerning both parts of energy consumption has been developed, based on the net present value method. An interval for the P-value, cultivation scheme, temperatures and three types of investments in the greenhouse (shadow-curtains, isolation-curtains and isolation of vertical walls) form the basis of the economic analysis. The results show that isolation of vertical walls is the best alternative in the production of potplants and of vegetables. Shadow-curtains and isolation-curtains are only profitable in a potplant production with a very big energy consumption. In a vegetable production it is not profitable to invest in these from an energysaving point of view. Sensitivity-analysis shows, that the profitability of the investments is very sensitive to changes in the energy price, the quantity of saved energy and changes in the output of the culture.

8769 **(NP—5770028) Studies on the reduction of pollutant emissions in a toxic waste incineration by means of a dry gas purification system.** Mueller, D. (Hamburg Univ. (Germany, F.R.). Fachbereich Chemie). 4 Aug 1983. 113p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number TI85770028.

A pilot project on dry deposition of acid noxious gases (HCl, HF, SO_3) downstream of a waste incineration plant for toxic waste (AVG Hamburg) was sponsored by the BMFT. In the experimental phase, the efficiency of the plant in the deposition of metal compounds in particle or vapour form was investigated. The solid filter residues had significantly high Pb, Cd, and Zn concentrations. The author concludes that the flue gas contains compounds of these metals in vapour form and that the dry sorption plant has a high retention efficiency for these compounds. The highly dispersive additives cause an adsorption of the finely distributed metal particles on the line hydrate surfaces. The alkaline additives cause the metals to bind to the solid sorbents so that they can be retained by the fibrous filter.

8770 **(PB—84-246339) Evaluation of a paint spray booth utilizing air recirculation. Final report June 1982-December 1983.** Norton, L.E.; Bryan, R.J.; Becvar, D.P. (Engineering-Science, Inc., Arcadia, CA (USA)). Aug 1984. 78p. NTIS, PC A05/MF A01.

The objective of this project was to evaluate the effectiveness of the recirculating air spray booth process at the Deere and Company facility in Davenport, Iowa. The effort involved a field measurement program and subsequent analysis of flow rates and emission data from the spray booth to define the degree of enhancement of the emissions stream and permit more efficient and economical control of spray booth emissions. Energy conservation became a matter of concern for industrial operators during the late 1970s when energy costs began to climb rapidly. Deere and Company engineers noted that heated in-plant air passed through the spray booth to the outside air. If this air could be recirculated while keeping worker environments within safety standards, significant energy cost savings could be achieved with an added benefit of the recirculation scheme being a reduction in emission volume. The reduction in emission volume can result in a significant reduction in volatile organic compound (VOC) control cost since only the quantity of make-up air must be controlled. Through rerouting the ductwork and modification of operator apparel to ensure worker safety, Deere and Company designed a recirculating air system that was patented in May 1981. Included in the design is a bleed stream which controls VOC buildup in the recirculating system by routing a portion of the air to a natural gas burner where it serves as combustion air and destroys the entrained VOC.

8771 **(PNL—5314) Potential conservation opportunities from the use of low-pressure irrigation in the Pacific Northwest region.** Harrer, B.J.; Lezberg, A.J. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1984. Contract AC06-76RL01830. 81p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85004090.

Four types of low-pressure irrigation technologies were examined in reference to their energy-savings potential and their costs per kWh of savings. Various conversion alternatives were selected for analysis from among the technologies of low-pressure single spray systems, low-pressure spray booms, furrow drop-tubes, and low-pressure impact sprinklers. A summary of the conversion alternatives that were analyzed and the major results for each alternative is presented. The energy-savings input parameters selected for use in this analysis were generally in the low range of available estimates and the cost input parameters were generally in the high range of available estimates.

3206 Municipalities And Community Systems

REFER ALSO TO CITATION(S) 3206008448, 8460, 8538, 8732, 8736, 8739, 9046

8772 **(ANL/CNSV-TM—144) Energy from municipal waste research: a technical review of thermochemical systems. Workshop proceedings.** Brooks, C. (comp.). (Argonne National Lab., IL (USA)). Sep 1984. Contract W-31-109-ENG-38. 324p. (CONF-840223—). NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE85001225.

From Energy from municipal waste research workshop - a technical review of thermochemical systems; Kissimmee, FL, USA (22 Feb 1984).

Separate abstracts were prepared for individual papers. (MHR)

8773 **(CONF-840414—4) Hourly values of power and heat demands and power purchasing conditions.** Munt, A. (Maschinenfabrik Augsburg-Nuernberg (M.A.N.) A.G., Augsburg (Germany, F.R.)). 1984. 37p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number TI85770040.

From 1984 Hanover fair; Hanover, F.R. Germany (4 Apr 1984).

The differentiation of the economy of a cogeneration plant with respect to time and value calls for the power and heat loads to be defined according to the seasons and according to the weekly and daily cycles. As a result, the consumption curve is obtained over the whole year with hourly values. EDP enables the vast amount of data to be handled. Now operation with various cogeneration configurations can be simulated and heat storage facilities can also be included. The result of such simulations defines the cogeneration plant configuration optimized for economy. This configuration will also meet the test of practical operation.

8774 **(CONF-8404199—) Problems of special wastes in waste management.** (Kommunaler Abfallbeseitigungsverband Saar, Saarbruecken (Germany, F.R.)). 1984. 551p. (In German). NTIS (US Sales Only), MF A01. File Number TI85770037.

From 4. colloquium on waste management; Saarbruecken, F.R. Germany (26 Apr 1984).

The problems concerning land filling, special waste disposal, waste combustion and flue gas purification are dealt with. 12 papers were entered separately.

8775 (CONF-8404199—, pp vp) **State of the art of refuse combustion in the Federal Republic of Germany.** Barniske, L. 1984. (In German). NTIS (US Sales Only), MF A01. File Number TI85770037.

From 4. colloquium on waste management; Saarbruecken, F.R. Germany (26 Apr 1984).

The paper demonstrates the possible scope of energy utilization with refuse incineration plants, emission reduction, treatment of residues as well as cost and profits.

8776 (CONF-8404199—, pp vp) **Reduction of emissions obtaining with refuse combustion by means of wet, semi-dry and dry processes.** Buekens, A.; Jacob, L.; Schoeters, J. 1984. (In German). NTIS (US Sales Only), MF A01. File Number TI85770037.

From 4. colloquium on waste management; Saarbruecken, F.R. Germany (26 Apr 1984).

Various fluegas treatment methods used in refuse combustion plants are demonstrated and assessed. With wet treatment, these plants are easily capable of fulfilling the demands made for pure gas. With dry gas treatment, however, there has been but restricted experience.

8777 (CONF-8404199—, pp vp) **Flue gas treatment with thermal waste utilization plants in Bavaria (domestic refuse).** Eichele, G. 1984. (In German). NTIS (US Sales Only), MF A01. File Number TI85770037.

From 4. colloquium on waste management; Saarbruecken, F.R. Germany (26 Apr 1984).

The development and plant technology of thermal waste utilization methods in Bavaria are demonstrated. Standards set by authorities and technological innovation contribute to the reduction of emissions in the field of fluegas treatment.

8778 (CONF-8404199—, pp vp) **Leaching behaviour of residues from waste combustion plant.** Fichtel, K. 1984. (In German). NTIS (US Sales Only), MF A01. File Number TI85770037.

From 4. colloquium on waste management; Saarbruecken, F.R. Germany (26 Apr 1984).

The leachates emerging from the slay-flyash landfill has an average salt burden of 30 g/l independent of the height or quantity of the combustion residues deposited. The reduced heavy metal concentration of the leach water is attributed to 1. the reduced solubility of heavy metal hydroxides in general, and to 2. the fixation of the dissolved heavy metals as sulphides and carbonates in the landfill body. Based on the examinations and supplementary considerations, it is assumed that hydrogen sulphide results from bacterial decomposition from sulphates and carbon dioxides through biological degradation of organic residues. Heavy metal fixation via sulphidization and carbonatization can be designated as auto-purification of the leachate of a slag-flyash landfill.

8779 (CONF-8404199—, pp vp) **Measurement results and experience gained with dry flue gas treatment downstream to refuse combustion.** Mohrenstecher, H.; Heilemann, G. 1984. (In German). NTIS (US Sales Only), MF A01. File Number TI85770037.

From 4. colloquium on waste management; Saarbruecken, F.R. Germany (26 Apr 1984).

A technically mature method for waste-water-free fluegas treatment was developed. This process is characterized among other things by its simplicity in process management and equipment technology. Pure gas values were obtained on operation of the experimental facility which were lower than those levels demanded by the TA-Luft (Technical Guidelines on Air) for concentrations of HCl, HF and dust emissions from waste combustion facilities. About 50% sulphur dioxide can be separated by means of justifiable additional expenditures.

8780 (DOE/ET/17037—T1) **USAF requirements analysis of advanced power systems study. Volume I.** (Dayton Univ., OH (USA). School of Engineering). Aug 1982. Contract AI01-80ET17037. 79p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85003448.

The Defense Department is investigating the potential savings in dollars of introducing new energy technologies into the DOD inventories now and in the future. This study evaluates the potential utilization of gas turbine, diesels, fuel cells, and Stirling engine generators in the DOD mobile inventory between 1980 and the year 2000. By using a computerized multiple criteria decision model, a previous study of the current and the future characteristics of the subject systems, and a DOD user preference program, the authors were able to determine the number of units by type of technology and size that should be procured annually to the year 2000 to replace the current DOD mobile generators. The impact of location, whether CONUS, overseas, or remote, was also considered. Replacements for the 250 and 750 kW units change with time, and the gas turbine, diesel, and Stirling engines are preferred. Fuel cells and Stirling engines are preferred for the 10 and 50 kW units. Both the replacement program life cycle costs and acquisition costs will exceed a billion dollars per year.

8781 (NP—5750390) **Energy supply in a rural community. Local energy planning in Nysted community.** Joergensen, K.; Gundermann, J. (Danmarks Tekniske Hoejskole, Lyngby. Fysisk Lab. 3). Jun 1983. 253p. (In Danish). NTIS (US Sales Only), PC A12/MF A01. File Number TI85750390.

A rural community was chosen as an average example of possible combined energy supply policy. The Nysted community can become self-sufficient and even power-supplier when all the local resources are taken into account. Biomass resources and a central biogas plant in Nysted are evaluated. Wind power and solar heating contributions are calculated for the integrated district heating and electric utilities, the present energy consumption and economic possibilities of the combined model with several renewable energy resources are considered in detail.

8782 (PB—84-243468) **Investigation of heat-shrinkable materials for use in the joints of district-heating pipes.** Schipper, B.A.; Geurts, W.S.M. (Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands)). 1984. 12p. NTIS, PC E03/MF E01.

Pub. in Kema Scientific and Technical Reports, v2 n5 p41-48 1984.

Heat-shrinkable materials are used for sealing joints in district-heating pipes. As several components of the pipes need protection against water, and since a large number of joints has to be constructed in the field, it is necessary to pay very close attention to the properties and the quality of the materials that are to be applied in the sealing of joints. This investigation has been concerned with the possibility of using thermo-analytical techniques in analyzing processes, occurring during the sealing process, in heat-shrinkable and additional materials. Furthermore, the consequences of some particular faults which may occur during the sealing procedure in the field, have been analyzed. The thermo-analytical techniques are adequate for the determination of all material properties that seem relevant, and for analysis of processes within the materials themselves.

8783 (STEV-BF—84-3) **Comparison between gasification and combustion of domestic solid fuels.** Edbom, Aa.; Wester, L. (Statens Energiverk, Stockholm (Sweden)). Jan 1984. 105p. (In Swedish). (ETU—2026-02). NTIS (US Sales Only), PC A06/MF A01. File Number TI85750451.

The report presents a comparison of two alternative heating systems, based on the major domestic swedish fuels, peat and wood. The systems studied were: 1. Gasification and distribution of the gas to the consumer. Systems for high, intermediate and low BTU gas are studied separately. 2. Combustion of the fuel in a heating plant and hot water distribution through a conventional district heating system. Plants of 5 and 50 MW are studied for each alternative. A plant size of 500 MW is treated more superficially. For the smaller plants, existing studies of district heating systems for the towns of Braecke and Varberg have been used. It is concluded that the district heating alternative is the cheapest for all plant sizes. This is true even if very liberal uncertainties are assumed for the gasification plants.

3209 Education And Public Relations

8784 **(FSEC-CR—57-82(EA)) Southeastern Renewable Energy Institute final project report.** LaHart, D.E. (Florida Solar Energy Center, Cape Canaveral (USA)). Aug 1982. Contract FG05-82ER75009. 97p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85000612.

This project taught key educators in Alabama, Georgia and Florida technical information concerning the pro's and con's about renewable energy and energy conservation as well as how and when to use the Solar Energy Project curriculum. In addition, participating educators were given the tools to plan and conduct workshops in their school districts to acquaint colleagues with the project.

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

REFER ALSO TO CITATION(S) 3300008945

3301 Internal Combustion Engines

REFER ALSO TO CITATION(S) 3301008440, 8457, 8761, 8790, 8790

8785 **(DFVLR-MITT—84-04) Hot-gas corrosion in aircraft engines.** Raetzer-Scheibe, H.J. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Koeln (Germany, F.R.). Inst. fuer Werkstoff-Forschung). 1984. 235p. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number TI85750565.

This report is a review of hot corrosion of high-temperature materials. In particular the corrosion behaviour of superalloys is considered at the special conditions in aircraft gas turbines. The known mechanisms are presented to explain corrosion phenomena of Ni-base and Co-base alloys. Among test methods the burner rig tests for simulation of processes in gas turbines are discussed in detail. The essential results of hot corrosion tests of Ni-base and Co-base alloys as well as protective coating systems are described.

8786 **(NP—5770061) Experimental studies of the rotary movement of a single-disk rotary piston engine.** Grimm, H.G. (Technische Univ. Berlin (Germany, F.R.). Fachbereich Konstruktion und Fertigung). 20 Jan 1981. 90p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number TI85770061.

The foundations for analysis and experimental studies of a rotary engine are elaborated. The studies are limited only to the rotation of the engine piston as they supply - with the exception of marginal conditions - the most important criteria for judging. Moreover the behaviour of rotary piston engines as drive machines in a compound system is studied. Furthermore an investigation has been carried out to find a functional model for the rotary piston engine using a procedure similar to the one used with reprocating piston engines. For these, the calculation of the ganging performance is often done with a kinetic substitution model; whether this is possible for rotary piston engine is studied too. Furthermore a description of the test stand and of the measuring equipment for dynamic engine testing is given. The test programme mainly consists of measurements on natural and forced oscillations and on the ganging performance of the engine, resulting in a comprehensive systems analysis.

8787 **(NP—5770066) Throughput of oil and demand for oil of non-stationary loaded sliding bearings in internal combustion engines.** Esch, H.J. (Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Maschinenwesen). 17 Dec 1981. 127p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number TI85770066.

The throughput of oil and the demand for oil of the non-stationary loaded sliding bearings was determined in a high speed petrol engine. The crankshaft bearing and connecting rod bearing were examined. The bearing temperature of the connecting rod bearing was measured by thermocouples built into this bearing; transmission of the signal from the rotating to the fixed part of the system was by means of a rotating transmitter. The temperature measurement in the crankshaft bearing was done by thermocouples in the bearing shell. Using a separate oil supply for the test bearing, the demand for oil was determined by reducing the oil pressure. Comparative oil throughput calculations were carried out to clear up the relationships discovered in the equipment. The results of the investigation are collected in 15 points, which are explained in detail. These include: negligible effect on the oil throughput of the ignition timing, air ratio and coolant temperature at constant speed and constant mean pressure, the considerable rise of the oil throughput through the connecting rod and crankshaft bearing with increasing speed, and the dominating effect of play in the bearing on the maximum bearing temperature.

3302 External Combustion Engines

8788 **(DOE/NASA/51040—57) Stirling materials technology.** Titran, R.H.; Stephens, J.R.; Scheuermann, C.M. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 29 Oct 1984. Contract AI01-77CS51040. 20p. (NASA-TM—86888; CONF-8410103—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004111.

From Automotive technology development contractors' coordination meeting; Dearborn, MI, USA (29 Oct 1984).

The Stirling engine is under investigation as an alternative to the internal combustion engine for automotive applications. The most critical component from a materials viewpoint is the heater head consisting of the cylinders, heating tubes, and regenerator housing. Materials requirements for the heater head include compatibility with hydrogen, resistance to hydrogen permeation, high temperature oxidation/corrosion resistance, and high temperature creep-rupture and fatigue properties. A continuing supporting materials research and technology program has identified the wrought alloys CG-27 and 12RN72 and the cast alloys XF-818, NASAUT 4G-A1, and NASACC-1 as candidate replacements for the cobalt-containing alloys used in current prototype engines. Based on this materials research program it is concluded that manufacture of the engine is feasible from low cost iron-base alloys rather than the cobalt alloys used in prototype engines.

3306 Vehicle Design Factors

8789 **(EGG-ED—6725) Techniques to analyze vehicle coastdown data.** Venhuizen, J.R. (EG and G Idaho, Inc., Idaho Falls (USA)). Oct 1984. Contract AC07-76ID01570. 41p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85005159.

Vehicle coastdown tests have been used for some time to generate data for estimating aerodynamic drag and tire rolling resistance. In spite of the numerous methods and techniques written up in the literature. The data taken do not represent measurements of the parameters of interest, rather, these parameters must be estimated from the measured data using some type of parameter estimation methodology. A method is presented which uses least squares parameter estimation techniques to estimate the aerodynamic drag and rolling resistance coefficients from velocity versus time data taken during the coastdown. Central to any parameter estimation problem is a model of the process that contains the parameters of interest. A model is developed to describe the coastdown process, and an example problem presented to show the computational methods developed for the data reduction process.

3307 Emission Control

REFER ALSO TO CITATION(S) 3307008877, 9044

3308 Alternative Fuels

REFER ALSO TO CITATION(S) 3308008440, 8455

8790 **(NIPER—19-Vol.3) Utilization research, Volume III. Quarterly technical report, July 1-September 30, 1984.** (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). 31 Oct 1984. Contract FC01-83FE60149. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004365.

Summaries of technical progress are presented for the following: (1) diesel fuel criteria; (2) direct utilization of aromatic feedstocks; (3) diesel exhaust characterization; and (4) coal slurry fuels for diesel engines.

36 MATERIALS

8791 **(DOE/ER/45051—01) Fracture toughness of materials. Progress report, February-October 1984.** Burns, S.J. (Rochester Univ., NY (USA). Dept. of Mechanical Engineering). 1984. Contract FG02-84ER45051. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004306.

Crack tip deformation in single crystals has been quantatively measured by observing screw and edge character dislocations at mode I and II crack tips. Each dislocation shields the true crack tip from the applied stress intensity factor. The thermal expansion of materials in a pressure-volume-temperature system has been proved to never change sign. The proof is based on the second law of thermodynamics.

8792 **Loading dilatometer.** De Jonghe, L.C.; Rahaman, M.N. (Center for Advanced Materials, Lawrence Berkeley Laboratory and Department of Materials Science and Mineral Engineering, University of California, Berkeley, California 94720). *Review of Scientific Instruments;* **55**: No. 12, 2007-2010(Dec 1984). Contract AC03-76SF00098.

A loading dilatometer has been constructed to study the sintering behavior of powder compacts subjected to low uniaxial stresses between 0 and 0.4 MPa and at temperatures up to 1250 K. A novel feature of the instrument is a device for the application of a controlled and measured stress to the sintering compact. Constant, as well as transient, stresses can be applied and the atmosphere inside the dilatometer can be controlled. Some representative results are reported.

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 3601008126, 8127, 8128, 8129, 8130, 8131, 8132, 8133, 8134, 8158, 8273, 8274, 8402, 8402, 8506, 8578, 8591, 8599, 8600, 8785, 8858, 8907, 8909, 8922, 8923, 8924, 8925, 8946, 9293

8793 **(AD-A—145361/2) Computer correction of resistance errors in polarization data. Technical report.** Gandhi, R.H.; Greene, N.D. (Connecticut Univ., Storrs (USA). Dept. of Metallurgy). Aug 1983. 16p. NTIS, PC A02/MF A01.

RESIST is a short microcomputer program that detects and corrects resistance (IR) errors in cathodic polarization data. It requires a minute or less to calculate the corrosion rate, the cathodic Tafel constant, and the resistance.

8794 **(AD-P—003951/1) Research and development requirements for ion implantation.** Parrish, P. (Army Research Office, Durham, NC (USA)). Jun 1984. 10p. NTIS, PC A02/MF A01.

This article is from 'Proceedings of the Ion Implantation for Army Needs Workshop Held at Watertown, Massachusetts on 30-31 July 1981,' AD-A145 474, p. 53-62.

This paper, on the research and development requirements for ion implantation, stresses the potential applications for corrosion reduction and conservation of critical materials.

8795 **(AD-P—003953/7) Use of ion implantation to modify the corrosion behavior of metals.** Sartwell, B. (Bureau of Mines, Avondale, MD (USA). Avondale Research Center). Jun 1984. 20p. NTIS, PC A02/MF A01.

This article is from 'Proceedings of the Ion Implantation for Army Needs Workshop Held at Watertown, Massachusetts on 30-31 July 1981,' AD-A145 474, p. 107-126.

This paper contains a short review of the Bureau of Mines Corrosion Research Program, in which ion implantation is being studied in connection with the conservation of critical imported materials and the substitution of more abundant domestic materials for imports.

8796 **(DOE/ER/04461—7) Micromechanical modeling of microstructural damage in creeping alloys. Final report.** Argon, A.S. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Mechanical Engineering). 15 Nov 1984. Contract AC02-77ER04461. 86p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85003925.

Fracture under service conditions at high temperatures in structures undergoing creep deformation is intergranular. Cavities on grain boundaries are produced on interfaces of hard particles during transient sliding of grain boundaries. The growth of grain boundary cavities by a combination of continuum creep and diffusional flow is often constrained by the creep deformation of the surrounding grain matrix. The constrained growth and linking of grain boundary cavities produces isolated cracked grain boundary facets which continue to grow by continuum creep and in the process accelerate overall creep flow. Cracked grain boundary facets are the principal form of creep damage, and their density per unit volume can be taken as the parameter characterizing creep damage. This damage parameter can be incorporated into three-dimensional constitutive relations of creep deformation, and these relations can be used in large strain finite element programs to solve complex engineering problems of creeping structures. All the microstructural mechanics that enter into the above description have been verified in a selection of key experiments on cavitation and crack growth.

8797 **(DOE/ER/45055—6) Summary of recent research on mechanical behavior of polycrystalline solids. Progress report, March 1984-March 1985.** Li, C.Y. (Cornell Univ., Ithaca, NY (USA)). Nov 1984. Contract FG02-84ER45055. 167p. NTIS, PC A08/MF A01; GPO Dep. File Number DE85004601.

The areas of study include: (1) a state variable approach to the analysis of transient creep deformation in stress reduction experiments; (2) a detailed study of the strain aging behavior of 316 stainless steel at room temperature; (3) a review of machine design, instrumentation and data analysis techniques for conventional mechanical testing at elevated strain rates; (4) a study of grain boundary sliding behavior and related deformation phenomena in Incoloy 800H at elevated temperatures; and (5) a review of progress in analytical and numerical research on the finite element modeling of non-elastic deformation processes using state variable constitutive laws. In general a state variable approach has been taken in developing a description of the deformation phenomena studied.

8798 **(DOE/ER/45116—4) Study of energy versus misorientation for grain boundaries in gold by crystallite rotation method. I. [001] twist boundaries.** Chan, S.W.; Balluffi, R.W. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering). Nov 1984. Contract FG02-84ER45116. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004598.

Small gold crystallites (~ 50 to 80 nm dia) were welded to thin film [001] single crystal gold substrates at a series of predetermined [001] twist angles in the range 0 to 45°. A pure [001] twist boundary therefore existed in each welded neck region which could be observed directly by transmission electron microscopy at normal incidence. Upon annealing, the crystallites rotated around [001] when the boundary energy varied with θ. The crystallites ro-

tated into three misorientations corresponding to the special Σ1 and Σ5 misorientations and a symmetry related misorientation at $\theta=45^{0}$. These results indicate the existence of grain boundary dislocation (GBD) related cusps on the boundary energy versus θ curve at Σ1 and Σ5. The rotations occurred conservatively by the motion of screw GBDs which could be observed directly by the transmission microscopy in certain regimes of θ. The results are relevant to recent calculations of the energies of [001] twist boundaries and the applicability of the GBD/structural unit model for grain boundaries.

8799 **(DP-MS—84-74) Hydrogen effects in austenitic stainless steels based on the Fe-Cr-Mn-N system.** Caskey, G.R. Jr. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1984. Contract AC09-76SR00001. 21p. (CONF-841157—27). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003617.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1984).

The effects of hydrogen on the mechanical properties of austenitic stainless steels have been examined extensively over the past ten years. One class of steels included in these studies is based on the Fe-Cr-Mn-N system and also may contain up to 13% nickel. These steels are characterized by a ductile-to-brittle transition that disappears as the nickel content is raised and by a generally higher strength than the 300-series austenitic steels. The effects of hydrogen on these Fe-Cr-Mn-N (Ni) steels have been reviewed and show that: small nickel additions greatly improve resistance to hydrogen damage; hydrogen solubility is greater than in Fe-Cr-Ni austenitic for the same conditions; hydrogen induced fracture mode changes are related to nickel content. These and other effects are discussed and compared to hydrogen effects in Fe-Cr-Ni alloys.

8800 **(EPRI-CS—3675) Nondestructive examination of steam turbine blades: an assessment. Final report.** Reinhart, E.R.; Porter, J.P. (Reinhart and Associates, Inc., Austin, TX (USA)). Nov 1984. 116p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920087.

Loss in utility plant availability created by failure-causing cracks in steam turbine blades makes early detection of this problem critical. Visual examination and magnetic particle testing are the nondestructive examination (NDE) methods usually utilized during field inspection of blades; however, there are reported instances where stress-corrosion cracks were missed. A consequence of missed cracks can be blade failure during operation, leading to costly unscheduled plant outage. To assess and alleviate this problem, the Electric Power Research Institute (EPRI) is carrying out a number of R & D efforts. This current study included an EPRI/EEI survey of the industry to define limitations of the current NDE practices for turbine blades, an evaluation of NDE methods using flawed blade samples, in-field test evaluations, and the development of standardized methods and procedures using state-of-the-art NDE methods. The study found that the NDE technique of eddy current, although not used extensively in the industry, could alleviate some of the problems associated with early detection of stress-corrosion cracks in the trailing edge of blades. In addition, the use of the ultrasonic testing technique appears suitable for development to detect cracks in blade tenons and in tie wires. Remote, in-place NDE of blades appears highly desirable and feasible. Results of the overall program are presented along with recommendations for future efforts, including development of test standards, optimizations of test techniques, and a plan for rapid transfer of technology to the utility industry. 15 references.

8801 **(FNAL-TM—1197) B vs H curves for 1008 and 1020 steels.** Ito, A.; Bosworth, W.; Visser, A.T.; Grimson, J.; Yang, W. (Fermi National Accelerator Lab., Batavia, IL (USA)). Jul 1983. Contract AC02-76CH03000. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004256.

For the purpose of investigating the saturation regions, we have measured the B vs H curves for the purchased 1008 and 1020 steels. In order to make a fair representation, the sample was chosen under the following conditions: (1) it was taken far away from the flame cutting region; (2) a hand saw was used to cut off the sample; and (3) finally the sample was machined into a toroidal shape of about 2″ OD, 1.75″ ID and 1/2″ height. We fabricated two samples of each type of steel in order to check the consistency of the measurements. For comparison, we plotted the curves on USS steel 1010 and 1020 respectively. The measured curves are similar to that of hot rolled types of steel.

8802 **(FRNC-TH—1557) Influence of mechanical and thermal treatments on microstructure and mechanical properties of titanium stabilized austenitic stainless steels.** Sidhom, H. (Paris-11 Univ., 91 - Orsay (France)). Dec 1983. 128p. (In French). NTIS (US Sales Only), PC A07/MF A01. File Number DE84752345.

Thermal and mechanical treatments for microstructure optimization in titanium stabilized austenitic stainless steels used in nuclear industry are examined. The steels studied Z10CNDT15-15B and Z6CNDT17-13 are of the type 15-15 Ti and 316 Ti. These treatments allow the elimination of casting heterogeneity produced by dendritic solidification, improve mechanical properties particularly creep and the best compromise between grain size solid solution of metal additions is obtained. Secondary precipitation of (TiMo)C on dislocations is improved by a previous strain hardening. The precipitation reinforce the good effect of strain hardening by stabilization of the microstructure producing a better resistance to recrystallization.

8803 **(IC—83/110) Flux pinning in La_{70} Cu_{30} disordered system.** Esquinazi, P.; Guillet, B.; Steinmann, R.; Dussell, H. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1983. 30p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700243.

Superconducting critical currents were measured as a function of a perpendicular applied magnetic field in disordered La_{70} Cu_{30}. It is shown that the pinning force is very sensitive to inhomogeneties already present in the as quenched samples, although these inhomogeneties have no obvious influence on other superconducting and transport properties. A simple series resistance model is used to explain the magnetic field dependence of the pinning force. A large decrease of the pinning force was obtained for the annealed samples. This behaviour is consistent with the phase separation model that explains the evolution of the superconductive penetration depth. In order to obtain a better characterization of the structural evolution with annealing of the La_{70} Cu_{30} system, behaviour of the electrical resistivity, superconducting critical temperature and differential thermal analysis were measured.

8804 **(INIS-BR—147) Properties of ABNT 41xx and 86xx cast steel modified with niobium; evaluation methodology and experimental preliminary results.** Suzczynski, E.F.; Chatterjee, S.; Mueller, Arno (Rio Grande do Sul Univ., Porto Alegre (Brazil). Dept. de Metalurgia). (Rio Grande do Sul Univ., Porto Alegre (Brazil). Dept. de Metalurgia). 1982. 14p. (In Portuguese). (CONF-8210153—). NTIS (US Sales Only), PC A02/MF A01.

From 1. meeting of technology and utilization of Brazilian steels; Rio de Janeiro, Brazil (13 Oct 1982).

The experimental methodology to evaluate the mechanical properties of ABNT 41xx and 86xx steels modified with NB in the as cast and heat treated conditions and the first preliminary results obtained in a laboratory scale, are presented.

8805 (INIS-SU—252, pp 3-6) **Primary damages by cascades of atom displacements in metaks.** Babaev, V.P.; Zabolotnyj, V.T.; Makhlin, N.A. (AN SSSR, Moscow. Inst. Metallurgii); Suvorov, A.L. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1983. (In Russian). NTIS (US Sales Only), PC A06/MF A01. File Number TI85780019.

In Radiation damage physics and radiation technology.

A comparison of analytical and numerical solutions of damage models of metals with the data of electro-and-ion microscopy study of the irradiated metals is given. It occurs when single cascades of atom displacement appear in their crystal lattice. An attempt is undertaken to derive the regularities allowing to predict some parameters of defect structure regions of single cascades

under different radiation conditions (volume, shape, vacancy concentration in depleeted sone).

8806 (INIS-SU—252, pp 52-53) **Structural radiation damage of transition metals at ion irradiation.** Gol'tsev, V.P.; Anishchik, V.M.; Uglov, V.V. (Belorusskij Gosudarstvennyj Univ., Minsk). 1983. (In Russian). NTIS (US Sales Only), PC A06/MF A01. File Number TI85780019.

In Radiation damage physics and radiation technology.

Surface layer structural variations of polycrystal massive samples of nickel and iron caused by carbon and boron ions are studied. The nickel and iron samples were irradiated with B^+ and C^+ ions at 45-60 keV energy, 10^{16}-$4x10^{17}$ ion/cm^2 integral doses at room temperature. The measurements were carried out by the X-ray diffractometric method using a sliding X-ray beam. As a result of the experiments the data are obtained allowing to make a conclusion that there occur noticeable structure variations in the near-layer zone in nickel and iron during ion implantation. The obtained results are interpreted assuming the existence of elastic stress fields.

8807 (INIS-SU—252, pp 75-79) **Pinning in the irradiated superconducting alloys of Ti-50 wt% Nb.** Ashimov, S.M. (Moskovskij Inzhenerno-Fizicheskij Inst. (USSR)); Naskidashvili, I.A.; Topchyan, L.S.; Bychkov, Yu.F. (AN Gruzinskoj SSR, Tbilisi. Inst. Fiziki). 1983. (In Russian). NTIS (US Sales Only), PC A06/MF A01. File Number TI85780019.

In Radiation damage physics and radiation technology.

By measuring mechanical forces acting on a superconducting sample in magnetic field at H > or approximately HsUb(k1) the pinning volume force Fsub(p)(H) in Ti - 50 wt.% Nb alloys With different preliminary thermomechanical treatment that subsequently is subjected to reactor irradiation by $3X10^{18}$ cm^{-2} fast neutron fluence at 160 K is studied. It is shown that in fields at H > 1.2 kOe Fsub(p) has large values in aged samples containing α-Ti phase precipitations of approximately 100 A size and relatively low ones in cold-worked and recrystallized samples. It is also shown that both low-temperature irradiation and subsequent annealing at 300 K mainly lead to the Fsub(p) decrease in all the tested samples.

8808 (INIS-SU—252, pp 80-82) **Peculiarities of helium release from copper irradiated with alpha particles.** Zaluzhnyj, A.G.; Storozhuk, O.M.; Cherednichenko-Alchevskij, M.V. (Moskovskij Inzhenerno-Fizicheskij Inst. (USSR)); Kadyrov, Kh.G.; Reutov, V.F. (AN Kazakhskoj SSR, Alma-Ata. Inst. Yadernoj Fiziki). 1983. (In Russian). NTIS (US Sales Only), PC A06/MF A01. File Number TI85780019.

In Radiation damage physics and radiation technology.

8809 (INIS-SU—252, pp 83-86) **Radiation influence of hydrogen plasma on mechanical properties of vanadium and niobium.** Gonoharenko, V.P.; Goncharenko, D.K.; Gritsyna, V.I.; Derepovskij, N.T.; Erko, V.F.; Ozhigov, L.S.; Rybalko, V.F. 1983. (In Russian). NTIS (US Sales Only), PC A06/MF A01. File Number TI85780019.

In Radiation damage physics and radiation technology.

8810 (INIS-SU—259, pp 223-224) **Exfoliation on gold, produced by 3,52 MeV $^4He^+$ bombardment at room temperature.** Pasti, F.; Pogany, L.; Mazey, G.; Kotai, E.; Manuaba, A.; Lohner, T.; Posh, L. (Academia R.S.R., Bucharest (Romania). Inst. de Fizica). 1982. NTIS (US Sales Only), PC A19/MF A01. File Number TI85780020. (CONF-8106209—Vol.4).

From 2. all-union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (23 Jun 1981).

The effect of 3.52 MeV $^4He^+$ ions irradiation on stratification and blister formation in cold-rolled gold specimens has been studied. The surface morphology and structure are studied using the method of scanning electron microscopy. The dimensions of structural formations are shown to increase with the dose. Boundaries of regions with laminated plates are located on the bottom and on the internal side of the surface. Different portions have different surface roughess. As a result of radiation hardening cracks located on the bottom and on the internal side of the surface are observed. Secondary blisters on the bottom side of the regions are detected. In a laminated film soft and radiation hardened layers are found. Such effects have been observed in stainless steel and inconel samples.

8811 (INIS-SU—259, pp 290-298) **Study on hydrogen isotopes interaction with materials for discharge chamber.** Vinogradova, N.K.; Ershova, Z.V.; Nikiforov, A.S.; Starshin, E.P. (Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Neorganicheskikh Materialov, Moscow (USSR)). 1982. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number TI85780020. (CONF-8106209—Vol.4).

From 2. all-union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (23 Jun 1981).

Experimental data on the effects of hydrogen isotopes (tritium, in particular) on materials of thermonuclear reactor units have been analyzed. Tables containing the constants for hydrogen isotopes permeability through austenitic steels and other alloys, diffusion coefficients, tritium solubility constants at temperatures 300-700 deg C are presented. It is shown that the diffusion mobility of hydrogen isotopes in different metals and alloys is approximately of the same order of magnitude, whereas data on the solubility for various metals differ by a factor of 10^8. A conclusion is drown that in the complex process of hydrogen isotope permeability the occlusion of the adsorbed atoms plays a considerable role.

8812 **(Juel—1904) Contribution to the high temperature deformation behaviour of the austenitic steel 1.4981 after neutron irradiation.** Thiele, B.A.; Schubert, F.; Nickel, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorwerkstoffe und Heisse Zellen; Technische Hochschule Aachen (Germany, F.R.)). Mar 1984. 119p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE85750079.

The austenitic steel 1.4981 thermomechanically treated to provide a range of microstructures has been irradiated at temperatures of 400-500°C with neutron fluxes of 1,55 x 10^{22} to 3 x 10^{25} m^{-2}. The degree of high temperature helium embrittlement caused by (n, α) nuclear reactions was determined in post-irradiation tensile and stress rupture tests at temperatures in the range 400-850°C. Under the irradiation conditions used, the production of helium within the grains was so great that the helium concentration at grain boundaries which leads to ductility loss was controlled by the diffusion of helium. At test temperatures below 700°C, the difference in the duration of tensile and of stress rupture tests has a significant effect. The test results show that the microstructural variations of the steel 1.4981 tested under the same conditions exhibited similar relative ductility loss. However, the absolute value of the rupture elongation after irradiation was proportional to the ductility of the material in the unirradiated condition, which was in turn dependent on the thermomechanical treatment. Specimens which had been embrittled by helium were found to contain numerous intercrystalline microcracks, which were orientated normal to the stress direction and eventually caused rupture. The elongation of the specimens resulted mainly from the widening of the microcracks; the grains themselves were not elongated to the same extent as found in unirradiated specimens. This explains why for the irradiated specimens little or no secondary creep was observed.

8813 **(Juel—1914) Hydrogen permeation through chromium.** Buchkremer, H.P.; Stoever, D. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung). May 1984. 50p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE85750075.

Steady state and non-steady state measurements of hydrogen permeation through metallic chromium are reported. The experiments have been conducted by use of hydrogen and deuterium within a pressure range of 10^{-9} - 1 bar and temperatures between 600 - 800°C. Numerical values for the physical quantities permeability, diffusion constant and solubility could be derived. At an upstream pressure above around 10^{-3} bar classical Sieverts-low was found (permeation rate proportional $\sqrt{p}$) with activation energies Qsub(perm) = 65 kJoule/mole, Qsub(Diff) = 4-8 kJoule/mole, Qsub(Sol) = 57-61 kJoule/mole for the respective processes involved. The isotopic effect between H and D of the permeabilities could be represented by a factor of 1,5 independence on tempera-

ture. All non steady-state measurements could be approximated reasonably well by classical diffusion kinetics. Below up-stream pressures of approx.= 10^{-7} bar the kinetics were no longer diffusion controlled, the dependence on up-stream pressure changed from $\sqrt{p}$ -> p, the activation energy for permetation increased to 127 kJoule/mole and the isotopic factor resulted in about 2-3.

8814 **(KFK—3622) New disordering mechanism in A15 type compounds submitted to low temperature irradiation or to quenching from high temperatures.** Fluekiger, R. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Technische Physik). May 1984. 22p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85750074.

A new diffusion mechanism describing the changes of the long range order parameter in A15 type compounds after both quenching from high temperatures or low temperature irradiation with high energy particles is presented. It is based on the occupation of nonequilibrium or 'virtual' sites centered halfway between two neighbouring A atoms on 6c sites, arising from the instability of a single 6c vacancy recently found by Welch and coworkers by pair potential calculations. After low temperature irradiation, the occupation of this interstitial site creates the necessary conditions for A <-> B site exchanges over several interatomic distances by focused replacement collision sequences. Due to the occupation of a certain concentration of virtual sites, atomic 'overlapping' is not only possible between A atoms on the chains or between A and B atoms (due to deviations from perfect ordering),but also between B atoms on BBB sequences. The latter are retained after low temperature irradiation only and are responsible for the observed lattice expansion and static displacement.

8815 **(LA-UR—84-3612) Some thoughts on alloy design.** Martin, P.L.; Williams, J.C. (Los Alamos National Lab., NM (USA); Carnegie-Mellon Univ., Pittsburgh, PA (USA)). 1984. Contract W-7405-ENG-36. 19p. (CONF-840417—10). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003775.

From High-temperature alloys - theory and design conference; Bethesda, MD, USA (8 Apr 1984).

This paper discusses some of the problems associated with attempts to use first principles in alloy design. We briefly summarize the role of microstructure on the properties of high temperature alloys and illustrate some of the microstructural features of conventional superalloys. We also describe how theory and experiment are converging toward some predictive capabilities for relating microstructure and composition using Ni-Al-Mo-X alloys as an example. Finally, this paper suggests that progress is being made in combining the results of condensed matter theory and experimental research.

8816 **(LBL—16999) Microstructural study on the processing and properties of high-field A15 superconducting materials.** Wu, I.W.D. (Lawrence Berkeley Lab., CA (USA)). Aug 1984. Contract AC03-76SF00098. 320p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE85004652.

Superconducting properties of high-field A15 materials were studied in terms of the physical and chemical states of the A15 phases. Higher critical current is achieved through microstructural control. The A15 materials investigated include the V_3Ga and Nb_3Al phases formed by a direct-precipitation process, the multifilamentary Nb_3Sn formed by the bronze-process, and the bronze-processed Nb_3Sn with a Mg addition. The direct-precipitation process has been found to have an intrinsically inferior critical current and lower stability, due to the large effective grain size, off-stoichiometric composition, and the high stability of bcc films between A15 grains. For the bronze-processed Nb_3Sn multifilamentary wire, microscopic examination reveals that the reacted layer consists of a three-shell composite structure. A mechanism to account for the formation of this structure is proposed. The critical current density is apparently determined by the areal fraction, grain size and composition of the central, fine-grained layer. Isothermal aging at intermediate temperatures (700 to 730°C) yields the best combination of microstructural features and the highest critical current. Double-aging treatments that start at 700°C and finish at 730°C improve the microstructural state of the A15 layer, and enhance the critical current density by approximately 50% at fields between 10 and 15T. Magnesium addition to the bronze matrix increases the attainable critical current density (100 to 300%) in bronze-processed multifilamentary Nb_3Sn wires as compared to the Mg-free wire at the nearly fully reacted heat treatment conditions.

8817 **(NP—5770047) Silicon-containing protective coatings of the composition Ni_4Cr_2Msub(refr.0.5)Sisub(3.5).** Daimer, J. (Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Chemie). 9 Jul 1982. 150p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number TI85770047.

This thesis relates to the study of the chemical and technological basis for silicon-containing protective coatings on nickel-base alloys. Coating of the type Ni_4Cr_2Msub(refr.0.5)Sisub(3.5) is carried out by reaction melting. The applicability of this method and its dependence on the type of refractory metal was ascertained by combined spreading/melting depth tests. The ignition temperature exerts a considerable influence on the silicon content of surface coating and this is confirmed by measurements of penetration depth of melt into the nickel base alloy. Transport coefficients and their temperature dependence are derived from measurements of silicon diffusion into the base material. From the diffusion values obtained, the penetration depth of silicon can be calculated in advance for different durations and temperatures. The phase composition of the silicon-containing protective coating applied as Ni_4Cr_2Tasub(0.5)Sisub(3.5) could be clarified. The rate of oxide layer formation was determined for the heterogeneously built up alloys coated as $NiCr_2$Msub(refr.0.5)Sisub(3.5) and Nisub(3.5)Cr_2Msub(refr.0.5)Si_4. In hot corrosion studies using sodium sulphate, sodium chloride and vanadium pentoxide as corrosion media, the superiority of the SiO_2-forming protective coating over uncoated nickel base alloys was demonstrated.

8818 **(NP—5770069) Metallurgy - materials development - recovery.** Bunk, W.; Boehmer, M.; Geyer, M.; Hansen, J.; Kissler, H.; Renn, C. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Koeln (Germany, F.R.). Projekttraegerschaft Metallurgie, Werkstoffentwicklung, Rueckgewinnung). 1983. 479p. (In German). NTIS (US Sales Only), PC A21/MF A01. File Number TI85770069.

Since 1975 the Institute for Materials Research of the DFVLR carries out the project management 'metallurgy, materials development, recovery' on the assignment of the BMFT (Federal Ministry of Research and Technology). The main task of the project is to prepare and carry out research task. This includes the scientific, technical and administrational advisory service for individual research and development projects starting with the first application through to granting and carrying out and accomplishing of a project. Presently 242 current R+D projects are supported. This projects are concerned with: metallurgical process engineering and materials developments with the sections: materials development NE-metals, powder metallurgy, fibre compound material, materials and components development ceramics, COST 50 'materials for gas turbines', COST 501 'high temperature materials for energy generation and conversion systems operated on fossile fuels, recovery, tribology. This survey contains a list of the current R+D projects and also of the ones that were terminated in the course of the last year; short descriptions of the projects and surveys on the joint Europeans actions COST 50 and COST 501 are supplied as well. The description of the tribology projects are not included. This booklet is not only meant for general information on the research sponsoring of the BMFT (Federal Ministry for Research and Technology) within the framework of project managing but also gives an opportunity to applicants or recipients of financial assistance to make contacts with other project leaders or to adapt their own application to the concept of the current subsidies.

8819 **(PB—84-235878) Thermal conductivity of aluminum, copper, iron, and tungsten for temperatures from 1 K to the melting point.** Hust, J.G.; Lankford, A.B. (National Bureau of Standards, Boulder, CO (USA). Chemical Engineering Science Div.). Jun 1984. 259p. (NBSIR—84/3007). NTIS, PC A12/MF A01.

Data on the thermal conductivity of commercially pure aluminum, copper, iron, and tungsten specimens have been collected,

coded, critically analyzed, and correlated with analytical techniques based on theoretical and empirical equations. The resulting functions are presented and used to generate tables and graphs of thermal conductivity as a function of temperature and residual resistivity ratio (RRR). An annotated bibliography of references is included. Discussions are included on the variations in thermal conductivity caused by chemical impurities, physical defects, size effects, and magnetic fields. Smoothed values are presented for temperatures from 1 K to near the melting point and for a large range of RRR values.

8820 **(PB—84-245927) Mechanical properties of welds in aluminum alloy 5083 at 4K. Final report.** Kelsey, R.A.; Mueller, L.N.; Elmer, J.W.; McHenry, H.I. (National Bureau of Standards, Washington, DC (USA)). Feb 1982. 17p. Pub. in Proceedings of International Aluminum Welding Conference (1st), Cleveland, OH, April 7-8, 1981, p. 89-105, February 1982.

A series of weldments were prepared by five cooperating companies in 51 mm thick 5083-0 aluminum plate using 5183 metal and gas metal arc welding (GMAW) processes. Tensile and notch-tensile properties measured at room temperature and at 4K are similar despite the fact that there were considerable variations in the welding procedures. Fracture toughness and fatigue crack growth rates of the weldments were measured at 4K and found to be similar to base metal properties. Strengths of the welds are appreciably higher at 4K than at room temperature, and notch yield ratios are high, indicating that the welds are tough. Data for each of the mechanical properties do not vary significantly from weld to weld; and it is concluded that the mechanical properties of 5183 welds at 4K do not depend significantly on GMAW parameters and procedures.

8821 **(RFP—3566) Summary of beryllium electrorefining technology developed by KBI Division of Cabot Berylco Inc.** Pistole, C.O. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 27 May 1983. Contract AC04-76DP03533. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003986.

Proprietary beryllium electrorefining technology has been purchased from the KBI Division of Cabot Berylco Inc. by Rockwell International, Rocky Flats Plant, as part of a DOE beryllium option study. This technology has been reviewed and is summarized. 12 figures, 7 tables.

8822 **(UCRL—91804) Behavior of stressed and unstressed 304L specimens in tuff repository environmental conditions.** Juhas, M.C.; McCright, R.D.; Garrison, R.E. (Lawrence Livermore National Lab., CA (USA)). Nov 1984. Contract W-7405-ENG-48. 37p. (CONF-850311—3). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004415.

From National Association of Corrosion Engineers annual meeting and materials performance and corrosion show; Boston, MA, USA (25 Mar 1985).

This paper presents preliminary results of an investigation of the behavior of candidate barrier material for high-level nuclear waste storage, Type 304L stainless steel, in tuff repository environmental conditions. Tuff is a densely welded, devitrified, igneous rock common to the proposed repository site at Yucca Mountain, Nevada. The results discussed include: irradiation corrosion tests, U-bend irradiation corrosion tests, slow strain rate tests, and bent beam stress corrosion tests. Results indicate that Type 304L stainless steel shows excellent resistance to general, localized, and stress corrosion under the environmental and microstructural conditions tested so far. The environmental test conditions are 50 to 100°C J-13 well water (non-saline, near neutral pH, and oxic in nature) and saturated steam at 100°C. Microstructural conditions include solution annealed and long furnace heat treatments to provoke a sensitized structure. However, this particular type of stainless steel may be susceptible to long-term, low-temperature sensitization because of the combination of expected time at elevated temperature and residual stress in the container after emplacement in the repository. Other grades of austenitic stainless steels are reported to be more resistant to low-temperature sensitization. Future work will therefore include more extensive testing of these grades. 15 references, 5 figures, 7 tables.

8823 **Fast method for calculating the self-consistent electronic structure of random alloys.** Johnson, D.D.; Pinski, F.J.; Stocks, G.M. (Department of Physics, University of Cincinnati, Cincinnati, Ohio 45221). *Physical Review [Section] B: Condensed Matter;* **30**: No. 10, 5508-5515(15 Nov 1984). Contract AC05-84OR21400.

We describe a computationally efficient method for performing self-consistent-field calculations of the electronic structure of random solid-solution alloys within the multiple-scattering coherent-potential-approximation formalism (KKR-CPA). We utilize a cluster method for solving the KKR-CPA equations and integrate along a contour in the complex-energy plane to reconstruct the single-site electronic densities.

8824 **Traveling-cluster approximation for uncorrelated amorphous systems.** Sen, A.K.; Mills, R.; Kaplan, T.; Gray, L.J. (Department of Physics, The Ohio State University, Columbus, Ohio 43210). *Physical Review [Section] B: Condensed Matter;* **30**: No. 10, 5686-5695(15 Nov 1984).

We have developed a formalism for including cluster effects in the one-electron Green's function for a positionally disordered (liquid or amorphous) system without any correlation among the scattering sites. This method is an extension of the technique known as the traveling-cluster approximation (TCA) originally obtained and applied to a substitutional alloy by Mills and Ratanavararaksa. We have also proved the appropriate fixed-point theorem, which guarantees, for a bounded local potential, that the self-consistent equations always converge upon iteration to a unique, Herglotz solution. To our knowledge, this is the only analytic theory for considering cluster effects. Furthermore, we have performed some computer calculations in the pair TCA, for the model case of δ-function potentials on a one-dimensional random chain. These results have been compared with "exact calculations" (which, in principle, take into account all cluster effects) and with the coherent-potential approximation (CPA), which is the single-site TCA. The density of states for the pair TCA clearly shows some improvement over the CPA and yet, apparently, the pair approximation distorts some of the features of the exact results.

8825 **Origin of the two-peak photoemission and inverse-photoemission spectra in Ce and Ce compounds.** Norman, M.R.; Koelling, D.D.; Freeman, A.J.; Jansen, H.J.F.; Min, B.I.; Oguchi, T.; Ye, L. (Materials Science and Technology Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review Letters;* **53**: No. 17, 1673-1676(22 Oct 1984).

The origin of the two-peak photoemission and inverse-photoemission spectra in Ce and its pnictide compounds (CeP, CeSb, and CeN) is investigated with ab initio total-energy self-consistent supercell energy-band and molecular-cluster approaches to represent physically the competing mechanisms involved in d or f electron screening (antiscreening in the case of inverse photoemission) of the local 4f electron excitations. Good agreement with experiment is obtained in all cases including the "anomalous" case of CeN.

8826 **In situ cleaning of nickel field-ion surfaces by neon ion bombardment.** Kellogg, G.L. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **2**: No. 4, 1597-1598(Oct 1984). Contract AC04-76DP00789.

Neon ion bombardment followed by field evaporation is shown to be a simple, effective procedure for cleaning the surface of nickel field-ion samples. The neon ions are generated by reversing the tip polarity and establishing a field emission current in the presence of the neon imaging gas. The procedure removes surface impurities which are resistant to field desorption at the evaporation field of nickel. The experimental conditions required to clean a nickel surface are presented.

8827 **Production of aluminum metal by electrolysis of aluminum sulfide.** Minh, N.Q.; Loutfy, R.O.; Yao, N.P. (to Dept. of Energy). US Patent 4,464,234. 7 Aug 1984. Filed date 1 Apr 1982. vp.

PAT-APPL-364282.

A method is disclosed for production of metallic aluminum by the electrolysis of Al_2S_3 at 700°-800° C. in a chloride melt composed of one or more alkali metal chlorides, and one or more alkaline earth metal chlorides and/or aluminum chloride to provide improved operating characteristics of the process.

8828 **Influence of stabilizing copper on the quench characteristics of Nb_3Sn wire.** Tsuchiya, K.; Suenage, M. (Brookhaven National Lab., Upton, NY). pp 969-976 of Advances in cryogenic engineering materials. Vol. 30. Clark, A.F.; Reed, R.P. New York, NY, USA; Plenum Press (1984). (CONF-8308180—).

From 5. international cryogenic materials conference; Colorado Springs, CO, USA (15 Aug 1983).

Recently there have been some attempts to construct 10 T dipole magnets using Nb_3Sn conductors for future high-energy particle accelerators. In past years there have been substantial commercial developments of Nb_3Sn multifilamentary wires with very high current densities, which are now available. However, few studies have been made of the electromagnetic stability of these wires, and it is not clear how much copper is required for stabilization of the conductor for these magnets. The authors have investigated the influence of the amount of stabilizing copper in a Nb_3Sn conductor on the quench energies and quench propagation velocities of Nb_3Sn multifilamentary wires at high magnetic fields. Measurements show that the optimum amount of copper for stabilizing the wire is about 38-45%. There is a clear correlation between the minimum quench energy and the quench propagation velocity of the specimen; the wire whose MQE is large has a low propagation velocity. The propagation velocity of 40% copper specimen at 10 T is almost the same order of magnitude as that of NbTi wire at 5 T, if they are compared at constant overall current density.

8829 **Critical current measurements on NbTi superconducting standard reference material.** Goodrich, L.F.; Clark, A.F.; Pittman, E.S.; Vecchia, D.F. (National Bureau of Standards, Boulder, CO). pp 953-960 of Advances in cryogenic engineering materials. Vol. 30. Clark, A.F.; Reed, R.P. New York, NY, USA; Plenum Press (1984). (CONF-8308180—).

From 5. international cryogenic materials conference; Colorado Springs, CO, USA (15 Aug 1983).

The National Bureau of Standards is producing a standard reference material (SRM) for the measurement of the superconducting critical current (I /SUB c/). Conductors were purchased from the inventories of each of the United States wire manufacturers. The conductor selected for the critical current SRM was despooled onto 500 distribution spools, each with about 2.2 m of wire. Measurements on a sample of the spools were used to determine the likely outcomes if the spools for distribution were measured. A carefully controlled acquisition and analysis system was developed to measure I /SUB c/. Two of the five candidate conductors displayed short or long-range inhomogeneity that made them seem unfit for use as an SRM. The conductor chosen for the SRM had substantial long and short-range variation in I /SUB c/; therefore the uncertainty statement was calculated using statistical tolerance limits. The resulting total uncertainty was within the objective of the study.

8830 **The effect of silicon impurities on superconducting properties of V_3Ga-Cu wire.** Gibson, E.D.; Schmidt, F.A.; Verhoeven, J.D. (Ames Laboratory, USDOE Iowa State Univ., IA). pp 797-803 of Advances in cryogenic engineering materials. Vol. 30. Clark, A.F.; Reed, R.P. New York, NY, USA; Plenum Press (1984). (CONF-8308180—).

From 5. international cryogenic materials conference; Colorado Springs, CO, USA (15 Aug 1983).

It is well established experimentally that Cu-V_3Ga composite superconductors exhibit higher J /SUB c/ values than comparable Cu-Nb_3Sn composites at magnetic fields above approximately 12 T. One major obstacle in the utilization of V_3Ga, however, is the high costs of both Ga and V metals. In this paper a method is considered for reducing the cost of the V metal. Also presented are data on J /SUB c/ versus Si content of the initial V metal for Si concentrations up to 3000 ppmw in both in situ V-Si-Cu wires and single core bronze processed V-Si-Cu wires. In situ Cu-V_3Ga was found to be easily fabricated over a wide range of Si impurity levels with no problem in mechanical reduction or diffusion to form V_3Ga. The addition of small amounts of Si improves the critical current density as long as the impurity levels are below 1000 ppmw for both bronze processed and in situ processed wire. The lower cost V containing several hundred ppmw Si is perfectly satisfactory for the fabrication of Cu-V_3Ga superconducting wire.

8831 **Manufacture and superconducting properties of bronze processed Nb_3Sn monofilamentary wires with Be additions.** Pan, J.Z.; Avitzur, B.; Chou, Y.T.; Suenaga, M. (Lehigh Univ., Bethlehem, PA). pp 754-762 of Advances in cryogenic engineering materials. Vol. 30. Clark, A.F.; Reed, R.P. New York, NY, USA; Plenum Press (1984). (CONF-8308180—).

From 5. international cryogenic materials conference; Colorado Springs, CO, USA (15 Aug 1983).

It has been demonstrated that cold hydrostatic extrusion can be used effectively in manufacturing Nb_3Sn superconductors by the bronze process. Also previously demonstrated was the reduction of strain degradation of the critical current by the addition of Be. This study describes the fabrication and testing of three sets of bronze-processed monofilamentary Nb_3Sn conductors, respectively containin 0.02, 0.1, and 0.22 wt.% of Be in a Cu + 11.3 wt. % Sn matrix. Because of the rapid hardening of the Be-alloyed samples, fabrication by wire-drawing becomes increasingly difficult as the bronze to niobium ratio increases. Therefore, hydrostatic extrusion was employed as the fabrication method. An optimal percentage of Be addition, estimated to be slightly less than 0.1 wt. %, was observed which minimizes the strain sensitivity of I /SUB c/. The optimum may result from two opposite effects, through work-hardening and diffusion.

8832 **Superconducting properties of Nb_3Sn multifilamentary wires fabricated by internal tin process.** Higuchi, N.; Klamut, C.J.; Suenaga, M.; Tsuchiya, K. (Brookhaven National Lab., Upton, NY). pp 739-746 of Advances in cryogenic engineering materials. Vol. 30. Clark, A.F.; Reed, R.P. New York, NY, USA; Plenum Press (1984). (CONF-8308180—).

From 5. international cryogenic materials conference; Colorado Springs, CO, USA (15 Aug 1983).

Since the discovery of the "bronze process" for fabrication of multifilamentary A15 superconducting wires, extensive efforts have been made to characterize the metallurgical and superconducting properties of these wires. One primary disadvantage of the manufacturing process is that the bronze matrix hardens rapidly with reduction in size such that the wires have to be annealed at an area reduction of about 50%. In order to avoid this difficulty, a new process, the internal tin process, was developed. This paper reports on the results of characterization studies of the wire's metallurgical and superconducting properties. The influence of heat treatment on the critical-current density of the wire is examined, showing that the size of the filaments can be an important variable in determining J /SUB c/ in these wires. The values of T /SUB c/ were measured showing significant differences for wires with and without the bronze matrix. This implies a significant compressive strain on the Nb_3Sn filaments. From the results, the authors conclude that a current density of 1200 A/mm² or somewhat higher may be achieved in a similar wire if an optimum filament size and heat-treatment condition are found.

8833 **The relationship between the martensitic phase transition and the superconducting properties of A15 compounds.** Welch, D.O. (Brookhaven National Lab., Upton, NY). pp 671-682 of Advances in cryogenic engineering materials. Vol. 30. Clark, A.F.; Reed, R.P. New York, NY, USA; Plenum Press (1984). (CONF-8308180—).

From 5. international cryogenic materials conference; Colorado Springs, CO, USA (15 Aug 1983).

Since the discovery of the structural transition in superconducting compounds, there has been intensive investigation of its nature, particularly of its relationship to electronic structure and its coupling to lattice distortions and phonons. The transition is usually called the "martensitic" transition. Because the structural and superconducting transitions probably are both manifestations of the same physical phenomenon, they are closely coupled: the spontaneous

lattice deformation which accompanies the martensitic transition causes a depression in the temperature of the superconducting transition, whereas if the superconducting transition occurs before the martensitic transition takes place, the latter will be suppressed. This paper contains a very brief discussion of the current theoretical ideas on the relation between the martensitic and superconducting transitions in A15 compounds and a brief review of the experimental evidence on the effect of pressure, alloying additions and radiation-induced disorder on the coupled transitions as well as the related tetragonal-strain dependence of the superconducting properties.

8834 **Fracture toughness of 25Mn austenitic steel weldments at 4 K.** Cheng, Y.W.; Inoue, T.; Li, P.N.; McHenry, H.I.; Ogawa, T. (National Bureau of Standards, Boulder, CO). pp 303-310 of Advances in cryogenic engineering materials. Vol. 30. Clark, A.F.; Reed, R.P. New York, NY, USA; Plenum Press (1984). (CONF-8308180—).

From 5. international cryogenic materials conference; Colorado Springs, CO, USA (15 Aug 1983).

One of the high-manganese steels developed for cryogenic applications is the 25Mn-5Cr-1Ni steel. Previous studies indicate that this steel has desirable cryogenic properties, i.e., high strength and high toughness, low thermal expansion coefficient, and stable austenitic microstructure. This paper presents the results of a weldability study in which fracture toughness measurements of the weldments were performed in liquid helium at 4K. The J /SUB Ic/ values of GTA, SMA and SA welds are 258, 221 and 119 kJ/m^2, respectively. The higher fracture toughness of some welds tested is attributed to fewer nonmetallic inclusions. For the case of the SMA weldment, the J /SUB Ic/ value of the material along the fusion line is similar to that of the weld metal. However, the J /SUB Ic/ value of the heat-affected zone is much lower. The degradation of fracture toughness of the HAZ is due to excessive precipitations of carbide along the grain boundaries, resulting in intergranular fracture.

8835 **Low temperature strengthening of austenitic stainless steels with nitrogen and carbon.** Reed, R.P.; Simon, N.J. (National Bureau of Standards, Boulder, CO). pp 127-136 of Advances in cryogenic engineering materials. Vol. 30. Clark, A.F.; Reed, R.P. New York, NY, USA; Plenum Press (1984). (CONF-8308180—).

From 5. international cryogenic materials conference; Colorado Springs, CO, USA (15 Aug 1983).

Austenitic steels have been used extensively in the construction of superconducting magnets. To restrain high field forces in the support structures, stronger alloys than the conventional AISI 300 series stainless steels must be developed and characterized for use at liquid helium temperatures. This paper examines quantitative effects of N and C on the strength of 18Cr-9Ni austenitic stainless steels at room temperature, 77K and 4K. The dependence of tensile yield on the percentage of N and C is analyzed. Nitrogen is found to contribute significantly more to strengthening than C in austenitic Fe-Cr-Ni alloys at low temperature; at room temperatures the contributions are essentially equal.

3602 Ceramics, Cermets, And Refractories

REFER ALSO TO CITATION(S) 3602008110, 8387, 8818

8836 **(BMI—2118) Multiaxial stress response of ceramics. Progress report, May 16-November 30, 1984.** Rosenfield, A.R.; Duckworth, W.H.; Shetty, D.K. (Battelle Columbus Labs., OH (USA)). 1 Dec 1984. Contract FG02-84ER45073. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004350.

Room temperature research was conducted on the strength of ceramics containing flaws associated with hardness indentations. Creep literature revealed that even uniaxial bending presents problems in data reduction due to complex stress profiles. (DLC)

8837 **(KFK—3773) Superconductivity, spin fluctuations and lattice instability of $V_2ZrH_{sub}(x)$.** Keiber, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Technische Physik; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Physik). Jul 1984. 60p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number TI85750471.

A calorimeter was reassembled in order to determine the specific heat of small specimens of only approx. 100 mg mass. The equipment has been so designed that measurements between 1.5 K and 30 K by the adiabatic method can be performed also in high external magnetic fields of 13 tesla. On the basis of calibration measurements on germanium at 0 and 13 tesla the upper limit of the measuring error can be given as proportional 2% with the possibility of resolving specific heats of 10^{-7} joule/kelvin. The equipment was used to measure the specific heat of the $V_2ZrH_{sub}(x)$ system. In combination with susceptibility and neutron scatter measurements individual Sommerfeld constants, γ, can be unequivocally attributed to the cubic and rhombohedral phases of V_2Zr. The value of lambda of 2.6 obtained by comparison with calculations of the band structure is in contradiction to the measured transition temperature of only 8.7 K provided that exclusive electron-phonon interaction is assumed. This result and the minor change of the transition temperature following drastic change of γ after the cubic -> rhombohedral phase transition was assigned to the influence of spin fluctuations. A homogeneous hydrogen load of V_2Zr is possible only above T proportional 260 k. Below this temperature the boundary of a two-phase domain is surpassed. With the help of measurements of the lattice constants as a function of the temperature it was possible to prepare a rough phase diagram.

8838 **(LA-UR—84-3496) Correlation of uniaxial and biaxial fracture strengths of ceramics.** Shetty, D.K.; Petrovic, J.J.; Rosenfield, A.R.; Duckworth, W.H. (Battelle Columbus Labs., OH (USA); Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 11p. (CONF-841203—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003779.

From 6. international conference on fracture; New Delhi, India (4 Dec 1984).

The increased utilization of brittle materials in structural applications has necessitated a need for better understanding of factors governing fracture strengths in multiaxial stress states. The research on which this paper is based examines the problem of relating fracture strengths of ceramics in biaxial stress states to strengths in uniaxial stress states. The problem is divided into two parts: in the first part fracture criteria for failure of brittle materials from single flaws are evaluated through controlled-flaw experiments in different stress states and fracture mechanics theory. The derived fracture criteria are then employed in a statistical fracture theory framework to predict strengths of ceramics failing from surface flaws.

8839 **(LA-UR—84-3524) Tensile testing of SiC whiskers.** Petrovic, J.J. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 13p. (CONF-8408133—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003712.

From Japan/US seminar on fundamentals of structural ceramics; Seattle, WA, USA (1 Aug 1984).

The room temperature tensile mechanical properties of SiC whiskers have been examined using a micro-tensile-test apparatus. SiC whiskers exhibit an average tensile strength of 8.4 GPa for a 5 mm tested length, and an average elastic modulus of 581 GPa. These results indicate that SiC whiskers possess significant potential as short-fiber reinforcement elements in ceramic matrix composites.

8840 **(RFP—3641) Characterization of Er_2O_3-substrate interfaces.** Larson, D.T.; Phillips, A.G.; Allen, T.H. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1980. Contract AC04-76DP03533. 16p. NTIS, PC A02. File Number DE85003955.

Results on the degree of substrate oxidation in the interface show that for substrates which have a high oxidation resistance, e.g., stainless steels, the processing environment does not affect the

amount of oxide formed in the interface. However, for substrates with low oxidation protection, it is imperative that vacuum processing be used to limit the substrate oxidation reaction. Examination of the Fe($M_{2,3}$VV) Auger electron peak, iron peak ratios $L_3M_{4,5}M_{4,5}$/$L_3M_{2,3}M_{4,5}$; $L_3M_{4,5}M_{4,5}$/$L_3M_{2,3}M_{2,3}$, and calculations of the amount of oxygen associated with the substrate in Er_2O_3-steel interfaces showed that after nitrate decomposition, the interface region consists mainly of a mixture of the substrate in a metallic state and Er_2O_3.

8841 **(UCID—20285-1) Materials Synthesis Program. Interim technical report No. 1, July 1-October 1, 1984.** Holt, J.B. (Lawrence Livermore National Lab., CA (USA)). Dec 1984. Contract W-7405-ENG-48. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004126.

Activities are reported for the following areas: combustion synthesis, laser-induced solid-solid combustion processes, materials synthesis (kinetics, sintering), and combustion synthesis in nickel/aluminum mixtures. (DLC)

8842 **(UCRL—90611) Kinetics of the combustion synthesis of titanium diboride (TiB_2).** Holt, J.B.; Kingman, D.D.; Bianchini, G.M. (Lawrence Livermore National Lab., CA (USA)). Nov 1984. Contract W-7405-ENG-48. 20p. (CONF-841250—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004414.

From International conference on engineering ceramics; Jerusalem, Israel (16 Dec 1984).

On the basis of our observations, the technique of measuring combustion waves in exothermic reactions offers distinct advantages in the study of solid-solid reactions at high temperatures. A complete analysis of the combustion mechanism should include the measurement of wave velocity, combustion temperature, and temperature profile. Our current research includes measurement of the temperature profile in the combustion reactions of TiB_2. The product of the combustion reactions described in this study is very porous. No attempt was made to try and decrease the porosity by change of initial density, particle size or particle size distribution, additives, etc.

8843 **Substrate signal suppression in Raman spectra of sputter deposited TiO_2 films.** Exarhos, G.J. (Pacific Northwest Laboratory, Richland, Washington 99352). *Journal of Chemical Physics;* **81**: No. 11, 5211-5213(1 Dec 1984). Contract AC06-76RL01830.

Polarized Raman scattering measurements of thin sputter deposited TiO_2 films on silica substrates are reported and demonstrate supression of substrate Raman scattering when one specific component of the scattered radiation is analyzed.

8844 **Physical parameters associated with the dielectric breakdown of MgO crystals at high temperatures.** Tsang, K.L.; Chen, Y.; Tohver, H.T. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Physical Review [Section] B: Condensed Matter;* **30**: No. 10, 6093-6102(15 Nov 1984). Contract W-7405-ENG-26.

The dielectric breakdown of MgO crystals at elevated temperatures is investigated as a function of such parameters as temperature, thickness, electric field, ambient atmosphere, electrode material, and impurity content. The prebreakdown electrical characteristics induced by these parameters are studied. Each parameter is investigated individually. The results are found to be compatible with the double injection model.

8845 **Neutron-diffraction study of the magnetic superconductors Dy(Ru/sub x/Rh/sub 1-x/)$_4B_4$.** Motoya, K.; Majkrzak, C.F.; Shirane, G.; Hamaker, H.C.; Maple, M.B. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] B: Condensed Matter;* **30**: No. 7, 3743-3749(1 Oct 1984).

Powder neutron-diffraction measurements have been performed for several concentrations on the system Dy(Ru/sub x/Rh/sub 1-x/)$_4B_4$, which displays varied and interesting types of magnetic and superconducting behavior. For the concentration $x = 0.15$, acollinear antiferromagnetic order with a peculiar temperature dependence of order parameters, including pronounced thermal hysteresis, coexists with the superconducting state. The nonsuperconducting $x = 1.00$ compound also develops long-range magnetic order, but with a ferromagnetic as well as an antiferromagnetic component. The diffraction pattern corresponding to a concentration $x = 0.60$, however, shows no long-range magnetic order for $T > 0.3$ K, but rather the development of a broad peak suggesting the onset of some short-range magnetic correlation.

8846 **(ORNL-tr—5155) Gas-phase separation in the system Ti-Si-C.** Nicki, J.J.; Schweitzer, K.K.; Luxenberg, P. Translated from *Journal of the Less-Common Metals ;* **26**: 335-353(1972). Contract AC05-84OR21400. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85000731. DE85000731

Chemical vapor deposition in the system Ti-Si-C has been studied with the reaction system $TiCl_4(g) + SiCl_4(g) + CCl_4(g) + H_2(ex)$. A complete deposition diagram at 1200°C and normal pressure has been constructed. The morphology and intergrowth in two- or three-phase equilibria, and especially the properties of the complex carbide Ti_3SiC_2 have been studied. In analogy to the deposition of binary systems in which the phases are deposited within a linear concentration range, the ternary phases (Ti_3SiC_2 or Ti_3Si_3C/sub x/) are deposited within two-dimensional concentration fields.

3603 Composite Materials

REFER ALSO TO CITATION(S) 3603008818

8847 **(AD-A—145578/1) Silane interphase of composites: effects of process conditions on gamma-aminopropyltriethoxysilane. Technical report.** Culler, S.R.; Ishida, H.; Koenig, J.L. (Case Western Reserve Univ., Cleveland, OH (USA). Dept. of Macromolecular Science). 4 Sep 1984. 37p. NTIS, PC A03/MF A01.

FT-IR spectroscopy was used to collect spectra of gamma-aminopropyltriethoxy silane (gamma-APS) coupling agent deposited on KBr plates, modelling the silane interphase of composites, to study the effects of heating the gamma-APS film under various environmental conditions. This coupling agent is used in fiber reinforced epoxy composites. An aminebicarbonate salt forms when the sample is dried in a moist carbon dioxide environment giving rise to a series of bands.

8848 **(PB—84-238773) Study of unrolling rupture under static stress and cyclic stress for composite carbon-epoxy materials.** Vancon, M.; Bathias, C. (Societe Nationale Industrielle Aerospatiale, 92 - Suresnes (France). Lab. Central). 13 Apr 1984. 82p. (Text in French). NTIS, PC E05/MF E05.

The study concerns the unrolling mechanism of carbon-epoxy composites for the purpose of interpreting the fractographic aspects of ruptures and perfecting the evaluation means. Unrolling was dealt with both for stress and shear. Due to the combined use of several observation methods: sweep microscopy, optic microscopy, radiography and exact determination of the mechanical rupture conditions, the authors combine in this report elementary models to explain the different aspect motives and the corresponding mechanisms.

8849 **(SAND—84-0714) Wavecode constitutive models: particulate-loaded composites.** Drumheller, D.S.; Trucano, T.G.; Chhabildas, L.C. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1984. Contract AC04-76DP00789. 60p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85004328.

In this report, we present the theory and computational implementation of a mechanical constitutive model for particulate-loaded composite materials. We also describe the experiments necessary to determine the material parameters demanded by the models. A major application of these materials is in explosively-stressed component systems. We discuss in detail the implementation of the constitutive model on the one- and two-dimensional Lagrangian wave propagation codes which are the major computational tools used in dynamic simulations.

8850 **(Y/DW—488) Ultrasonic analysis of Kevlar-epoxy filament wound spherical test specimens.** Brosey, W.D. (Oak Ridge Y-12 Plant, TN (USA)). 6 Dec 1984. Contract AC05-84OS21400. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85005198.

Increased use of composite materials in enclosed geometries such as cylindrical, spherical, or conical shapes has led to the desire to transfer and further develop the most promising nondestructive evaluation (NDE) techniques used on nonenclosed geometries to enclosed geometries. Known defects were placed within spherical Kevlar-epoxy filament wound test specimens to determine the extent to which they could be detected. These defects included Teflon shim-simulated delaminations, macrosphere-simulated voids, dry-band sets, variable tension, Kevlar 29 fiber, and an alternate high void content winding pattern. Ultrasonic C-scan analysis of Kevlar-epoxy filament wound spheres was performed to determine detectability of normal winding patterns and implanted flaw conditions in the composite using this technique. Ultrasonic waveform analysis was performed in both the time and frequency domains to determine the detectability and locatability of structural flaws within the composite.

8851 **Stiffness and internal stresses of woven-fabric composites at low temperatures.** Kriz, R.D. (National Bureau of Standards, Boulder, CO). pp 1-8 of Advances in cryogenic engineering materials. Vol. 30. Clark, A.F.; Reed, R.P. New York, NY, USA; Plenum Press (1984). (CONF-8308180—).

From 5. international cryogenic materials conference; Colorado Springs, CO, USA (15 Aug 1983).

Woven-fabric composites are used in superconducting magnets and to contain cryogenic liquids. These materials provide thermal and electrical insulation and can be subjected to large mechanical and thermal loads. The present paper shows that stiffness and internal stresses of woven composite laminates can be predicted by a generalized plane-strain finite-element model of a unit cell. Internal stresses are influenced strongly by warp orientation and thermal contraction. Internal delamination stresses near the warp-fill interface decrease with thermal contraction at 77K. The matrix region is most influenced by thermal contraction and warp orientation.

8852 **Magnetic impurity scattering in in situ superconductors.** Finemore, D.K.; Kogan, V.G.; Miller, S.L.; Yang, H.C. (Ames Laboratory--USDOE, Ames, IA). pp 909-915 of Advances in cryogenic engineering materials. Vol. 30. Clark, A.F.; Reed, R.P. New York, NY, USA; Plenum Press (1984). (CONF-8308180—).

From 5. international cryogenic materials conference; Colorado Springs, CO, USA (15 Aug 1983).

Measurements of ac losses for in situ prepared superconducting composites consistently show loss values higher than those observed for bronze process materials. If there were no cross coupling between filaments the ac losses would be much lower. There is, in fact, both proximity coupling and some cross joining of filaments so the losses are substantially higher. The goal of this work is to understand quantitatively the origin of this coupling between filaments and to develop methods for controlling it. Presented here are the results of a study of the model system Pb-(AgAlMn)-Pb to understand all the basic physics involved and to learn quantitatively the effects of magnetic impurity scattering in the normal layer. Because both magnetic and nonmagnetic scattering will be important in the Cu-Nb_3Sn systems, both Mn and Al are added to the Ag to determine the effects of both the magnetic scattering rate and nonmagnetic scattering rate. The results from the model system show that the theory of Makeev et al. for the bridge geometry also describes the sandwich geometry providing that the temperature is less than about 60% of T /SUB c/. This, in turn, provides an analytical guide for the design of practical conductors.

3604 Polymers And Plastics

8853 **(UCID—20281) Thermal-stress analysis by coupling NIKE2D and TACO2D.** Gerhard, M.A. (Lawrence Livermore National Lab., CA (USA)). 10 Jul 1984. Contract W-7405-ENG-48. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004129.

Several tank track designs were evaluated for the heating of the rubber pads. NIKE2D was used to analyze the rubber pads under mechanical loading and TACO2D to calculate thermal distributions within the pads. (DLC)

3606 Other Materials

REFER ALSO TO CITATION(S) 3606008411, 8921, 9027

8854 **(AD-A—145420/6) Investigation of chemical durability mechanisms in fluoride glasses. Report No. 1 (annual) April 1983-June 1984.** Simmons, C.J.; Simmons, J.H. (Catholic Univ. of America, Washington, DC). 10 Aug 1984. 52p. NTIS, PC A04/MF A01.

Aqueous corrosion mechanisms are investigated in heavy-metal fluoride glasses. The family of glasses based on the Zirconium tetrafluoride glass former is rapidly attacked by water which is either unbuffered or contains acidic components. However, these glasses resist corrosion by basic solutions. ThF4-based glasses exhibit a higher resistance. Comparisons are made between the 2 glass families; pH dependence of corrosion is analyzed and a corrosion model is presented.

8855 **(BNL—35427) Measurement of the induced moment magnetic form factor of a heavy fermion superconductor.** Stassis, C.; Axe, J.D.; Majkrzak, C.F.; Batlogg, B.; Remeika, J. (Brookhaven National Lab., Upton, NY (USA); Bell Labs., Murray Hill, NJ (USA); Ames Lab., IA (USA)). Oct 1984. Contract W-7405-ENG-82;AC02-76CH00016. 13p. (CONF-841184—23; IS-J—1513). NTIS, PC A02/MF A01; GPO Dep. File Number DE85004165.

From 30. annual conference on magnetism and magnetic materials; San Diego, CA, USA (27 Nov 1984).

Polarized neutron scattering techniques have been used to study the spatial distribution and temperature dependence of the magnetization induced in a single crystal sample of $CeCu_2Si_2$ by a magnetic field of 50 kOe. We find that at 4.2°K (> T/sub c/) the induced magnetization is predominantly of 4f electronic character. No evidence was found of any change in the magnetic form factor between 300 and 4.2°K.

8856 **(DOE/ER/10598—5) Characterization of high temperature electrically conducting oxides.** Anderson, H.U.; Sparlin, D.M. (Missouri Univ., Rolla (USA)). Oct 1984. Contract AC02-80ER10598. 18p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004296.

The goal of the investigation reported on herein was to study the interrelationships between electrical conductivity, oxidation-reduction kinetics, defect structure, and composition of n- and p-type binary and ternary transition metal oxides. The experimental part of the investigation included specimen preparation, thermogravimetric measurements, x-ray diffraction, transmission electron microscopy, electrical conductivity, electron paramagnetic resonance, and Seebeck measurements. The oxide systems studied were La-doped $SrTiO_3$, La-doped $BaTiO_3$, Mg-doped $LaCrO_3$, Mg-doped $LaMnO_3$, Sr-doped $LaMnO_3$, Mg- and Li-doped Cr_2O_3, and Nb- and Ta-doped TiO_2. The electrical conductivity, carrier mobility, and defect concentration for several of the systems are discussed in detail. The most important results were obtained for the $SrTiO_3$, $LaCrO_3$, Cr_2O_3, $BaTiO_3$, TiO_2, and $LaMnO_3$ systems for which the oxygen activity and temperature stability ranges of the electrical conductivity are defined. A particularly significant result is that the stability range of $LaMnO_3$ is influenced by the particular element with which it is doped. For example, Sr-doped $LaMnO_3$ is much more stable towards reduction than is Mg-doped $LaMnO_3$. Another important result is that the chemical diffusion coefficient of oxygen in $LaCrO_3$ is very high, which implies that oxygen diffusion through $LaCrO_3$ should be fast. It was also learned that the electron mobility in $SrTiO_3$ is not constant with carrier concentration.

8857 **(DOE/ER/45053—1) Cation dopant effects on the lattice thermal expansion of cordierite. Progress report, November 1, 1983-October 31, 1984.** Predecki, P.K. (Denver Univ., CO (USA)). Nov 1984. Contract FG02-84ER45053. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003991.

X-ray lattice thermal expansion results on cordierite doped with Li, Be, B, P, Ca, Zn, and Ge ions showed that the a-axis expansion is largely unaffected by the dopants, while the c-axis expansion showed erratic behavior. A neutron experiment was also conducted and the results reported in detail. A mechanism is proposed for the expansion process. (DLC)

8858 **(IC—83/104) Theoretical and experimental studies of the stability in CVD Nb_3Sn superconducting composite tapes.** Zhang, Q.; Song, S.; Jiao, Z. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1983. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700242.

The dynamic stability of CVD Nb_3Sn superconducting composite tapes has been studied. Considering plastic yield of the materials and based on a two-dimensional model, the stability criteria have been obtained theoretically. Using the above criteria, one can show that there exists an optimum thickness of the copper cladding, at which a maximum of the overall critical current density can be reached. The theoretical results are in good agreement with our experiments with simulation coils or with the reported results. Based on the theory of the dynamic stability, the unification of the cryostatic, dynamic and adiabatic stability has been discussed.

8859 **(IC—83/237) Effect of uniaxial stress on the acceptor ground state and on the hopping conduction in p-type germanium and silicon.** Buczko, R.; Chroboczek, J.A. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1983. 64p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85700216.

We constructed variational wave functions, with correct asymptotic behaviour, for the ground state of shallow acceptors in Ge and Si, utilizing the spherical tensor representation of the effective mass hamiltonian of Baldereschi and Lipari (1973), at uniaxial stress, X, resulting from the application of a tensile or compressive force along the [001] orientation (respectively $X<0$ or $X>0$). Energies of the components of the ground state, computed variationally, account very well for the X-induced displacements of the binding energies and the stress splitting of shallow acceptors in both Ge and Si, at $X>0$ (no data for $X<0$ are available). The wave functions were further used for computing the stress variation of resistivity, rho(X) for hopping conduction involving single transitions between the stress-split components of the ground acceptor state, within the framework of percolation theory. Graphic representation of the critical surfaces for percolation, and their evolution with X are provided. Our calculations account adequately for rho(X) in Ge samples with low acceptor concentration for both $X<0$ and $X>0$. However, they account only qualitatively for the rho(X) data available for Si ($X>0$ only), probably because of a larger chemical shift of the acceptor ground state in Si and its possible variation with X. At larger acceptor concentrations rho(X) decreases, at large X, much stronger than predicted for both Ge and Si. We attribute this discrepancy to the increase of the contribution to electron transport of multiple hopping transitions at large X values.

8860 **(IC—84/24) Empirical tight-binding band structure of wurtzite semiconductors: SiC, ZnSe and ZnTe.** Tuncay, C.; Tomak, M. (International Centre for Theoretical Physics, Trieste (Italy)). Mar 1984. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700217.

The electronic energy band structures in an sp^3 tight-binding model of the wurtzite semiconductors SiC, ZnSe and ZnTe are reported.

8861 **(IC—84/25) Localized orbital description of Si, Ge and GaAs.** Erbarut, E.; Tomak, M. (International Centre for Theoretical Physics, Trieste (Italy)). Mar 1984. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700218.

The simplest Gaussian orbitals of s and p symmetry are employed for the study of electronic band structures of Si, Ge and GaAs. An accurate description of the valence and conduction bands are attained.

8862 **(Juel—1894) Static pyrocarbon deposition in the temperature range of 1900°C-2000°C.** Seeberger, D.; Luhleich, H.; Nickel, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorwerkstoffe und Heisse Zellen; Technische Hochschule Aachen (Germany, F.R.)). Feb 1984. 192p. (In German). NTIS (US Sales Only), PC A09/MF A01. File Number DE85750077.

By means of static pyrocarbon-depositions, it was the aim to contribute to the understanding of the formation and the deposition of pyrocarbon. To achieve this target, a statistical test programme was applied, which enabled the reduction of the necessary individual trials to only 10 with coincident variation of three independant test-variables. The boundary layer over heated substrates in gaseous atmospheres, the Langmuir zone, was evaluated in various gases by optical means; the structure of the Langmuir zone could be defined. The combination of the results from strcutre evaluations and evaluations from the Langmuir zone led to a better understanding of the pyrolysis procedure; a hypothesis on this subject could be confirmed. A proposal was made to describe the structure of high density pyrocarbon completely. A method for planimetric evaluation of single film exposures was developed and applied. A procedure was also developed for coincident determination of the temperature of two heated objects, and this method could be mathematically verified.

8863 **(LA-UR—84-3486) UFe_4P_{12} and $CeFe_4P_{12}$: nonmetallic isotypes of superconducting $LaFe_4P_{12}$.** Meisner, G.P.; Torikachvili, M.S.; Yang, K.N.; Maple, M.B.; Guertin, R.P. (Los Alamos National Lab., NM (USA); California Univ., San Diego, La Jolla (USA). Inst. of Pure and Applied Physical Sciences; Tufts Univ., Medford, MA (USA). Dept. of Physics). 1984. Contract W-7405-ENG-36. 12p. (CONF-841184—20). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003724.

From 30. annual conference on magnetism and magnetic materials; San Diego, CA, USA (27 Nov 1984).

The new compound UFe_4P_{12}, which was found to be isostructural to superconducting $LaFe_4P_{12}$ and with a lattive constant of 7.7729 A, is a semiconductor and shows ferromagnetic order below 3.15 K. $CeFe_4P_{12}$ is also a semiconductor and its magnetic susceptibility is unusually small in comparison to $LaFe_4P_{12}$. The semiconducting behaviors of both UFe_4P_{12} and $CeFe_4P_{12}$ seem anomalous and may arise from strong f-electron hybridization.

8864 **(PB—84-243948) Evaluation of properties of varnishes, exterior stains and exterior primers. Final report 30 July 1983-30 April 1984.** Willner, J.J.; Spindel, S.; Levinson, S.B. (DL Labs., New York (USA)). 6 Jun 1984. 87p. (DL—6189; DL—6311). NTIS, PC A05/MF A01.

This report presents the results of a project to evaluate the performance of recently developed water-based and low-solvent varnishes, exterior stains and exterior primers to determine if these products have properties equivalent to the conventional high-solvent products which are now used for the same purpose. Products were solicited from a select group of coating and raw material suppliers. A total of 16 companies responded, submitting samples of 30 low-solvent and 25 conventional coatings, including interior and exterior varnishes, semi-transparent and opaque stains, and primers. Standard ASTM test methods were used. Some of the new products tested had performance properties equivalent to or better than the conventional high-solvent coatings. The appendices contain test data and procedures.

8865 **(RFP—3551) Characterization of natural chabazite and 5A synthetic zeolites.** Stakebake, J.L.; Fritz, J. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1984. Contract AC04-76DP03533. 17p. NTIS, PC A02. File Number DE85004100.

An investigation was begun to characterize the thermal, outgassing, adsorption, surface areas, and porosity properties of these

materials. Samples of Linde and Davison 5A synthetic zeolites were also characterized for comparison purposese. This paper discusses the results of this investigation.

8866 **(RFP—3656) Characterization of the thermal surface, and oxygen adsorption properties of Type 4A and 5A synthetic zeolites.** Stakebake, J.L.; Fritz, J. (Rockwell International Corp., Golden, CO (USA)). 1984. Contract AC04-76DP03533. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004695.

Thermal and surface properties of a Davison 4A zeolite were investigated using DTA, TGA, and oxygen adsorption at -196°C. Surface properties of a Linde 5A zeolite were also evaluated using oxygen adsorption and compared with similar properties determined by nitrogen adsorption. Temperature programmed desorption analyses were performed using the TGA data and showed the activation energy for water desorption to be 7.8 kcal/mol. Adsorbed water was found to inhibit oxygen adsorption, but this inhibiting influence was reduced by increasing the outgassing temperature and eliminated by outgassing at 200°C or higher. Pore volumes and diameters were determined using the MP method. Total pore volume was 0.225 cm^3/g for the 4A and 0.261 cm^3/g for the 5A. These values agreed well with those calculated using other methods. Pore diameters determined from oxygen adsorption were about 6 A which was greater than previously reported and indicated that this method was not sensitive enough to determine pore sizes with an accuracy greater than 1 to 2 A.

8867 **(SAND—84-1293C) Evaluation of implantation-disordering of (InGa)As/GaAs strained-layer superlattices.** Myers, D.R.; Barnes, C.E.; Arnold, G.W.; Dawson, L.R.; Biefeld, R.M.; Zipperian, T.E.; Gourley, P.L.; Fritz, I.J. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 8p. (CONF-841157—24). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003533.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1984).

We have examined the optical and transport properties of $In_{0.2}Ga_{0.8}As/GaAs$ strained-layer superlattices (SLS's) which have been implanted either with 5 x $10^{13}/cm^2$, 250 keV Zn^+ or with 5 x $10^{14}/cm^2$, 70 keV Be^+ and annealed under an arsenic overpressure at 600°C. For both cases, electrical activation in the implantation-doped regions equalled that of similar implants and anneals in bulk GaAs, even though the Be implant retained the SLS structure, while the Zn implant intermixed the SLS layers to produce an alloy semiconductor of the average SLS composition. Photoluminescence intensities in the annealed implanted regions were significantly reduced from that of virgin material, apparently due to residual implant damage. Diodes formed from both the Be- and the Zn-implanted SLS's produced electroluminescence intensity comparable to that of grown-junction SLS diodes in the same chemical system, despite the implantation processing and the potential for vertical lattice mismatch in the Zn-disordered SLS device. These results indicate that Zn-disordering can be as useful for strained-layer superlattices as in lattice-matched systems.

8868 **Structural properties, superconductivity, and magnetism of metallic hydrogen.** Min, B.I.; Jansen, H.J.F.; Freeman, A.J. (Department of Physics and Astronomy, Northwestern University, Evanston, Illinois 60201). *Physical Review [Section] B: Condensed Matter;* **30**: No. 9, 5076-5083(1 Nov 1984).

The electronic band structure and structural properties of paramagnetic metallic hydrogen in the simple cubic (sc), fcc, bcc, and hcp phases have been determined theoretically using our bulk full-potential total-energy linearized augmented-plane-wave method. In the density range corresponding to 1<r/sub s/<2 we find a phase transition from sc to hcp at high pressure which indicates the importance of the hcp structure in phase transformations of molecular hydrogen under pressure. Superconducting transition temperatures up to 250 K are predicted within the framework of the rigid-ion approximation. An analysis of the Stoner factor shows the expected magnetic instability in the low-density region.

8869 **Explosive recrystallization during pulsed laser irradiation.** Narayan, J.; Pennycook, S.J.; Fathy, D.; Holland, O.W. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **2**: No. 4, 1495-1497(Oct 1984). Contract AC05-84OR21400.

The phenomenon of explosive recrystallization has been studied in Si^+ and Cu^+ implanted amorphous silicon layers by electron microscopy and Rutherford backscattering techniques (RBS). Cross-section and plan-view electron microscopy techniques (TEM) have been used to obtain a detailed characterization of microstructures associated with the explosive mode of recrystallization. RBS and analytical TEM studies on segregation of copper provided information on the mechanism of explosive recrystallization involving a thin liquid film interposed between crystallized and uncrystallized regions.

40 CHEMISTRY

4001 Analytical And Separations Chemistry

REFER ALSO TO CITATION(S) 4001008154, 8178, 8178, 8183, 8305, 8305, 8305, 8364, 8392, 8432, 8902, 9384

8870 **(BNL—35536) Perfluorocarbon measurement using an automated Dual Trap Analyzer.** D'Ottavio, T.; Goodrich, R.W.; Dietz, R.N. (Brookhaven National Lab., Upton, NY (USA)). Oct 1984. Contract AC02-76CH00016. 21p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004042.

A new instrument designed to measure perfluorocarbon concentrations in air has been developed at BNL. This instrument, called the Dual Trap Analyzer, is reviewed in this paper along with some current applications. Perfluorocarbons are collected on a solid adsorbent and then thermally desorbed, separated by gas chromatography and detected by electron capture. A new measurement is obtained every 2 to 10 minutes depending on the number of perfluorocarbons present in the collected air sample. The limit of detection for a collection time of two minutes is 0.005 parts per trillion for any one of the four perfluorocarbons that have been studied.

8871 **(DOE/METC—84-30) Nonintrusive technique for the measurement of vapor-phase alkali in products of combustion gases.** Romanowski, C.; Anderson, R.J. (USDOE Morgantown Energy Technology Center, WV). Sep 1984. 21p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84012016.

A nonintrusive measurement technique based on atomic emission spectroscopy was used to measure the release of vapor phase alkali from burning coal particles. The measurements were quantified with the method of additions by introducing specific quantities of alkali compounds into the combustion zone. Measurements involving Arkwright coal indicated that about 50% of the sodium and 33% of the potassium were vaporized in a CH_4/air flame for near stoichiometric conditions. These particular values are believed to be dependent upon combustor conditions. Additional experiments should be completed at pressure and with various coal types to further characterize alkali release during combustion. 3 references, 8 figures, 5 tables.

8872 **(EGG-M—16384) Separation of americium from tervalent lanthanides for high-resolution alpha spectrometry.** Sill, C.W. (EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 4p. (CONF-8410197—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003553.

From 30. annual conference on bioassay, analytical and environmental chemistry; Cincinnati, OH, USA (10 Oct 1984).

A simple and efficient method for the separation of americium from many elements including the tervalent lathanides was developed by Moore (1963, Anal. Chem. 35:715) based on oxidation of the americium to its hexavalent state with ammonium peroxydisulfate in a weak nitric acid solution in the presence of silver ion as a catalyst. The non-oxidizable lanthanides and actinides were then

precipitated with ammonium fluoride and filtered off, leaving the hexavalent americium in solution as a soluble fluoride complex. The present procedure is similar to that of Moore but with significant differences that permit both high chemical yield and excellent resolution to be obtained using the entire americium fraction from 10 grams of soil to obtain maximum sensitivity and precision by high-resolution alpha spectrometry. The procedure was developed specifically for application to the 4 M nitric acid strip of a bis(2-ethylhexyl)phosphoric acid extract from which most of the cerium from a 10-gram sample had been removed by extraction after oxidation with sodium bromate.

8873 **(GKSS—84/E/20) Application of nuclear analytical methods to heavy metal pollution studies of estuaries.** Anders, B.; Junge, W.; Knoth, J.; Michaelis, W.; Pepelnik, R.; Schwenke, H. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1984. 15p. (CONF-840408—18). NTIS (US Sales Only), PC A02/MF A01. File Number TI85750470.

From 5. international conference on nuclear methods in environmental and energy research; Mayaguez, Puerto Rico (2 Apr 1984).

Important objectives of heavy metal pollution studies of estuaries are the understanding of the transport phenomena in these complex ecosystems and the discovery of the pollution history and the geochemical background. Such studies require high precision and accuracy of the analytical methods. Moreover, pronounced spatial heterogeneities and temporal variabilities that are typical for estuaries necessitate the analysis of a great number of samples if relevant results are to be obtained. Both requirements can economically be fulfilled by a proper combination of analytical methods. Applications of energy-dispersive X-ray fluorescence analysis with total reflection of the exciting beam at the sample support and of neutron activation analysis with both thermal and fast neutrons are reported in the light of pollution studies performed in the Lower Elbe River.

8874 **(INIS-BR—138) Determination of the uranium concentration in apatite by the fission - track registration technique.** D'Oliveira Cardoso, D. (Instituto Militar de Engenharia, Rio de Janeiro (Brazil)). 1983. 131 p.p. (In Portuguese). NTIS (US Sales Only), PC A07/MF A01. File Number TI85780087.

The feasibility of using the fission-track registration technique to determine the uranium content in the phosphate rock beneficiation steps carried on by CompanhiA Arafertil, Araxa, Minas Gerais, Brazil is studied. This determination is of considerable interest to the environmental control of the Arafertil installations as well as of its surroundings or of the areas where these products will be used. The so-called wet method was adopted and a 10 μm polycarbonate foil, fabricated by Bayer under the trade name Makrofol KG was used as detector. From the calibration curve obtained, it was possible to determine uranium contents in sample solutions ranging from 21 to 212 μg U/l with an accuracy of 8 to 14.7%, respectively. The results obtained demonstrated that the technique used is appropriate to the purposes previously aimed at.

8875 **(INIS-BR—148) Determination of V, W and Mn in high-speed steel by neutron activation source of ^{241}Am/Be.** Villar, H.P.; Galdino, S.M.L.; Godoy, M.O.; Dantas, C.C. (Pernambuco Univ., Recife (Brazil). Dept. de Energia Nuclear). (Pernambuco Univ., Recife (Brazil). Dept. de Energia Nuclear). 1982. 15p. (In Portuguese). (CONF-8210153—). NTIS (US Sales Only), PC A02/MF A01. File Number TI85780088.

From 1. meeting of technology and utilization of Brazilian steels; Rio de Janeiro, Brazil (13 Oct 1982).

Alloying elements are responsible for certain characteristics of the steels which enable their utilization for specific purposes. The concentrations of these elements must comply with strict standards, and the determination of these concentrations involve chemical analyses which are as a rule tedious and expensive. It is proposed here a fast and precise analytical process based on the neutron activation analysis. A significant correlation ($r = 0.998$) between manganese concentration and mean specific count rate of ^{56}Mn was obtained for activated tool steel samples. Later on, bases for tungsten and vanadium determinations were set.

8876 **(INIS-SU—259, pp 235-241) Light impurity measurements by 2-4 MeV $^4He^+$ beam using recoil detection and forward scattering.** Kotai, E.; Mezey, G.; Pasti, F.; Lokhner, T.; Manuaba, A.; Posh, L. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). 1982. NTIS (US Sales Only), PC A19/MF A01. File Number TI85780020. (CONF-8106209—Vol.4).

From 2. all-union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (23 Jun 1981).

The paper deals with light impurity measurements by 2-4 MeV $^4He^+$ beam using recoil detection and forward scattering. The forward scattering method is extended down to the energy region of a standard Van de Graaf accelerator, preserving most of the advantageous properties i.e. versatility and high sensitivity. It still requires thin film targets. The 2 MeV analysis shows that the 15 MeV detector resolution causes interferences in the recoiled spectrum. The recoiled hydrogen, carbon, oxygen and the scattered part of ^{3}H or ^{3}He cannot be separated properly. By 2 MeV beam only ^{3}H and ^{4}He are measurable.

8877 **(IS-T—1160) Extraction of palladium(II) using Cyanex 471 extractant and supported liquid membrane.** Walker, R.D. (Ames Lab., IA (USA)). Dec 1984. Contract W-7405-ENG-82. 63p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85004175.

Thesis.

Cyanex 471 has potential in separating Pd(II) from chloride solutions containing Pt(IV). Liquid-liquid extraction equilibria studies have demonstrated that Cyanex 471 could be used to recover palladium(II) from spent automotive catalysts. The distribution equilibria and solution chemistry of the $PdCl_2$-HCl-H_2O-Cyanex 471-xylene system is straightforward until $PtCl_4$ is added to the system, upon which the system becomes extremely complex with various complexing reactions competing at the interface. Cyanex 471 has a major problem in applications using supported liquid membranes. The extracted palladium complex becomes saturated and precipitates as a dark brown solid before diffusion of the complex across the membrane can occur. Since the loading capacity of Cyanex 471 is very high, this is not a problem in solvent extraction. In supported liquid membrane extraction, the capacity of the membrane to retain Cyanex 471 in its tortuous pores is limited, causing precipitation of the palladium complex into the feed solution. All the changes made on the system parameters in this study failed to overcome this problem. However, results of the solvent extraction study indicate that supported liquid membrane technology could be applied to the separation and concentration of palladium(II) if the proper apparatus could be designed. Such a design would need a much higher membrane surface area to feed solution volume ratio than that used in this study. It should be run at palladium concentrations that keep interfacial complexing below the Cyanex 471 loading capacity.

8878 **(MINTEK-SP—4) Manual of analytical methods used at MINTEK.** Stoch, H.; Dixon, K. (Council for Mineral Technology, Randburg (South Africa)). 1983. 318p. NTIS (US Sales Only), PC A14/MF A01. File Number TI85780086.

The manual deals with various methods for a wide range of elemental analysis. Some of the methods that are used include atomic absorption spectroscopy, optical emission spectroscopy and x-ray fluoresence spectroscopy. The basic characteristics of the method are given and the procedures are recorded step by step. One of the sections deals with methods associated with the recovery of uranium.

8879 **(NP—5750420) Methods for analysing organic vapor and matters in hot gas flows.** Andreasen, H. (Teknologisk Inst., Tastrup (Denmark)). Jan 1984. 37p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. File Number TI85750420.

The aim of the project was to find general methods for sampling and analysis of organic matters in hot gas flows and try to adopt these methods to the analytical equipment of the laboratory. The work carried out consists of a literature survey and a small experiment. By combusting untraditional energy sources such as

wastes, it may be important to define certain organic compounds in the gas flow, e.g. the flue gas, for the process control or air pollution evaluation. This report includes only the sampling technique and the control possibilities that exist by controlling the methods, and it does not include the sampling strategy for sampling of organic micro pollutants in flue gas.

8880 **(PB—84-246289) Evaluation of analytical methods for the determination of POHC (principal organic hazardous constituents) in combustion products. Report for June 1982-May 1984.** James, R.H.; Adams, R.E.; Finkel, J.M.; Miller, H.C.; Johnson, L.D. (Southern Research Inst., Birmingham, AL (USA)). Sep 1984. 30p. NTIS, PC A03/MF A01.

The paper gives results of an evaluation of gas-chromatography/mass-spectrometry (GC/MS) and high-performance liquid chromatography (HPLC) methods for determining about 150 compounds from a list of potential principal organic hazardous constituents (POHCs), as defined in 40 C.F.R. Part 261, Appendix VIII. The methods evaluated are presented, analytical results are given, and the application of the evaluated methods to the determination of POHCs in incinerator effluents is discussed. These methods do not represent EPA's official method. (NOTE: As part of the Resource Conservation and Recovery Act (RCRA), the EPA has proposed regulations for owners and operators who treat hazardous waste by incineration. To ensure that these incinerators operate in an environmentally responsible manner, the regulations include a requirement that, for selected POHCs, a destruction and removal efficiency (DRE) of equal to or greater than 99.99% must be achieved (40 C.F.R. Part 264, Section 264.343). The evaluation of this paper is part of the supporting documentation for permit writers and for the incinerator-facility owners and operators.

8881 **(RFP—3561) New ion exchangers and solvent extractants for pre-analysis separation of actinides. Annual report, June 1982-May 1983.** Navratil, J.D. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1 Jun 1983. Contract AC04-76DP03533. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003982.

Prior to radiochemical determination of actinide elements such as uranium, neptunium and plutonium, an ion exchange or solvent extraction method is often employed to separate these from themselves and other interfering elements. In order to improve the separation efficiency and reduce time, cost, and liquid waste of analytical separation methods, new and better ion exchangers and solvent extractants are under evaluation. New microreticular and macroreticular anion exchange resins and bifunctional organophosphorus solvent extractants have been evaluated for uranium, neptunium and plutonium separations. Previous work comparing numerous anion exchange resins has shown the macroreticular Amberlite IRA-938 resin as having the highest actinide capacity and best elution kinetics. Recent studies have confirmed the resin has advantages over others for Pu-U separations. Work at Rocky Flats on bifunctional organophosphorus solvent extractants for the recovery and purification of actinides has led to the identification of several new separation systems applicable for radiochemical analysis. Dihexyl-N,N-diethylcarbamoylmethylphosphonate (DHDECMP), its dibutyl analog DBDECMP, and DHDECMP-tributylphosphate (TBP) using liquid-liquid or extraction chromatography techniques are applicable for plutonium-americium and plutonium separations. Both DHDECMP and DBDECMP extract actinides strongly, extract lanthanides, iron, gallium, molybdenum, titanium, vanadium, zirconium partially, and do not extract most other elements from 5 to 7M nitric acid. With the DHDECMP-TBP and DBDECMP-TBP systems, synergistic effects have been observed for both plutonium and americium. The chemistry and application for pre-analysis separations of these solvent extraction systems are described. 11 references, 9 figures, 7 tables.

8882 **(RFP—3600) Rocky Flats plans for Inductively Coupled Plasma (ICP) analysis of impurities in plutonium materials.** Michel, C.E.; Brown, G.E. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1983. Contract AC04-76DP03533. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003899.

Dihexyl N-N diethylcarbamoylmethylene phosphonate (DHDECMP) has proven to be an effective complexing agent for separating plutonium and americium from many impurities. Perhaps its biggest drawbacks are cost and availability in high purity form (~ 85%). Recycle usage of the extractant is a practical method of overcoming the cost disadvantage. Separation of uranium from many impurities using DHDECMP and subsequent ICP analysis of the impurities has been successfully demonstrated. The technique will be verified for plutonium when the containment box is completed. 7 references, 2 figures, 6 tables.

8883 **(RFP—3624) Synthetic and process material nondestructive assay calibration standards.** Sherrill, R.D.; McBride, J.D.; Navratil, L.H. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1983. Contract AC04-76DP03533. 25p. NTIS, PC A02. File Number DE85003915.

Two general approaches to nondestructive assay (NDA) chemical standard preparation and certification have been successfully employed at the Rocky Flats Plant. The fabrication of synthetic standards is a low cost method of obtaining standards with well characterized special nuclear material (SNM) content, but this approach may result in instrument calibration biases due to unanticipated matrix effects. Certification of process material with chemical and/or NDA measurements requires more effort and normally results in a higher uncertainty for the SNM content. The latter approach does, however, produce standards with a matrix that is more representative of the process stream, thus improved instrument calibrations result. Examples of both calibration techniques are discussed. 7 references, 18 figures, 1 table.

8884 **(RFP—3625) Ferrite use in separation science and technology.** Boyd, T.E.; Cusick, M.J.; Navratil, J.D. (Rockwell International Corp., Golden, CO (USA)). 1983. Contract AC04-76DP03533. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003905.

Ferrites having a variety of compositions have proven to be useful as a separation tool for a wide range of materials. These include dissolved metal species, particulate matter, and a variety of organic and biological materials. In addition, ferrites can be used as catalysts for the conversion of noxious gases from waste gas streams. Ferrites have been used almost exclusively for waste treatment applications. Their rather strong separation capability has generally precluded their use for more selective separation applications. The versatility of the ferrite treatment technique is further evident in the wide variety of application methods. Unlike the solids from other types of waste treatment, ferrite solids can be regenerated for reuse or be used in various other applications.

8885 **(RFP—3643) Field test and evaluation of the Simultaneous Calorimetric Assay System.** Rakel, D.A.; Wetzel, J.R.; Elmont, T.E. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). [1985]. Contract AC04-76DP03533. 4p. NTIS, PC A02. File Number DE85003959.

The Simultaneous Calorimetric Assay System measures the thermal power of the sample by calorimetry and at the same time the relative concentrations of the heat producing nuclei in the sample. This transportable instrument provides a nondestructive determination of the plutonium content of the sample. This paper describes the instrument itself and its performance in a field test and evaluation performed by the Chemical Standards Laboratory at Rocky Flats in the summer of 1983.

8886 **(SRDP-R—106) Investigation of ^{144}Pr measurements for determination of residual Pu in FBR leached hulls.** Yates, A.; Bremner, W.B. (UKAEA Atomic Energy Research Establishment, Harwell. Safeguards R and D Project). Dec 1983. 7p. NTIS (US Sales Only), PC A02/MF A01. File Number TI84703471.

The measurement of plutonium in leached hulls arising from FBR fuel reprocessing is required for plant control, accountancy and safeguards. At DNPDE these measurements are carried out on the batch of hulls prior to bulking into 200 l drums for retrievable storage and ultimately further treatment for plutonium recovery. The experience to date has related to the use of neutron interrogation using sealed tube neutron generators as the irradiation source. The supply of replacement sealed tubes has become difficult. It was

therefore decided to consider, amongst other techniques, the measurement of 144 Pr gamma emission as a possible alternative. The technique has been extensively used for thermal reactor fuels on a routine basis. There has also been a limited amount of work reported from Cap La Hague on applying the technique to FBR fuels as part of an experimental programme. This paper therefore describes the work done at DNPDE which evaluated the technique for use on a batch of hulls arising from a PFR fuel reprocessing campaign.

8887 **Determination of trace elements in serum using inductively coupled plasma atomic spectroscopy with hydride generation and chelating resin preconcentration.** Mianzhi, Z.; Barnes, R.M. (Department of Chemistry, University of Massachusetts, GRC Towers, Amherst, Massachusetts 01003-0035). *Applied Spectroscopy;* **38**: No. 5, 635-644(Sep 1984). Contract AC02-77EV04320.

A procedure is described for the inductively coupled plasma emission spectroscopic determination of Cd, Co, Cu, Fe, Mo, V, and Zn in <1 mL of serum after digestion in nitric and perchloric acids and preconcentration with a poly(dithiocarbamate) resin. Recoveries are 91 to 106%. The determination of As and Se in serum by hydride generation and ICP-AES is performed after the interference of Cu on Se hydride generation was reduced by complexation of the Cu with poly(acrylamidoxime) resin. Verification with NBS-SRMs as well as with human sera samples is reported.

8888 **Spectrochemical analysis of liquids using the laser spark.** Cremers, D.A.; Radziemski, L.J.; Loree, T.R. (University of California, Los Alamos National Laboratory, Chemistry Division, P.O. Box 1663 Los Alamos, New Mexico 87545). *Applied Spectroscopy;* **38**: No. 5, 721-729(Sep 1984).

A laser-generated spark was used to analyze liquids spectroscopically for elemental constituents. The spark was produced directly in liquids by a focused laser pulse of 15 ns duration and an energy of about 45 mJ/pulse. The size, temperature, and electron density of the spark are reported. Emissions from once-ionized and neutral atoms and simple molecules were observed. Limits of detection for Li, Na, K, Rb, Cs, Be, Mg, Ca, B, and Al in aqueous solutions were established with the use of a 10 Hz repetitive single spark (RSS). Most of these elements were only detectable at levels above 1 μg/mL, although the detection limit for Li was 0.006 μg/mL. The relative standard deviation for replicate sample analysis was 4-8%. The detectability of some species was enhanced with the use of a 10 Hz repetitive spark pair (RSP): a pair of sparks separated in time by about 18 μs. The detection limits for B/H_2O with the RSP and the RSS were 80 and 1200 μg/mL, respectively. Species were also detected in organic solvents, and in flowing samples. The laser spark method of liquid analysis would be useful in situations requiring noninvasive monitoring of species at high or moderate concentrations.

8889 **Electrothermal sample introduction system for ICP spectrometry.** Matusiewicz, H.; Barnes, R.M. (Department of Chemistry, GRC Towers, University of Massachusetts, Amherst, Massachusetts 01003-0035). *Applied Spectroscopy;* **38**: No. 5, 744-753(Sep 1984). Contract AC02-77EV04320.

An adaptation of commercial electrothermal atomizers is presented for inductively coupled plasma spectrometry. The modifications were undertaken to optimize the efficiency of atomization for ICP. The design and specifications of the atomizer are described in detail.(AIP)

8890 **(BG-Trans—5775) Separation of the acid and basic fractions of coal liquefaction products: high performance liquid chromatography.** Holstein, W.; Severin, D. Translated from *Erdoel und Kohle, Erdgas, Petrochemie vereinigt mit Brennstoff-Chemie ;* **34**: No. 2, 77-80(Feb 1981). 10p. NTIS (US Sales Only), PC A02. File Number TI85900239. TI85900239

The acid and basic fractions of coal liquefaction products were separated by several different methods by using high performance liquid chromatography, for example, separations on normal and reversed phase columns, reversed phase ion pair chromatography, as well as isotatic and gradient elution. Before analyzing the acid fraction, it was separated in phenolic compounds and organic acids. It is shown that sharp fractions are yielded. It appears that reversed phase chromatography is the best method applicable, although ion pair chromatography gives some analytical advantages when applied to basic fraction. 11 references, 10 figures, 1 table.

8891 **(DP-tr—71) Modeling and simulation of a multistage-contactor for solvent extraction.** Oh, W.Z.; Kim, C.; Lee, T.H. Translated from *Hwahak Konghak ;* **15**: No. 5, 355-363(1977). Contract AC09-76SR00001. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001368. DE85001368

The hydrodynamic characteristics of Multistage Mixer-Settlers were studied by establishing a mathematical model based on the assumptions of complete mixing in the mixer and plug flow with CSTR recirculation in the settler. The model parameters were determined by the moment and time lag matching and experiments were carried out with a water-kerosene system by obtaining residence time distributions for both phases using impulse response technique. The suggested model well predicted the experimental results within the experimental error range, while the other existing models were found to be too idealized to depict the dynamic characteristics of this equipment.

4002 Inorganic And Physical Chemistry

8892 **(AD-A—145373/7) Trivalent ion exchange in beta' alumina. Technical report.** Dunn, B.; Farrington, G.C. (Pennsylvania Univ., Philadelphia (USA). Dept. of Materials Science and Engineering). 6 Jul 1984. 5p. (TR—6). NTIS, PC A02/MF A01.

Ion exchange techniques were used to substitute trivalent cations for the sodium ions present in sodium beta alumina single crystals. Complete replacement was achieved using Gd3+, Nd3+, and Eu3+ ions in molten salts. The conductivity of Gd3+ beta alumina was measured and optical properties of Nd3+ exchanged materials were studied. The trivalent beta aluminas appear to be the first solid electrolytes to exhibit rapid trivalent cation motion at moderate temperatures.

8893 **(DOE/ER/04447—186) Physical-chemical studies of transuranium elements. Progress report, April 1, 1984-March 31, 1985.** Peterson, J.R. (Tennessee Univ., Knoxville (USA). Dept. of Chemistry). 1985. Contract AS05-76ER04447. 38p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85004463.

The following are reported: spectroscopic studies of selected actinides in molten dimethyl sulfone; absorption spectrophotometric study of actinide halides under pressure; spectroscopic investigations of americium (V) and (VI) in concentrated aqueous carbonate-hydroxide solution; calculation of magnetic moments of actinide oxides from Dirac scattered wavefunctions; spectrophotometric studies of the coordination of californium(III) ions in selected lanthanide hosts; redox studies of lanthanides and actinides in molten oxide-hydroxide salt systems; and fluorination studies of lanthanides and actinides.

4003 Organic Chemistry

REFER ALSO TO CITATION(S) 4003008109, 8148, 8266, 8267, 8268, 8269, 8270, 8272, 8279, 8280

8894 (DOE/BC/10345—2, pp 98-112) **Synthesis and performance of isomer-free secondary alkane sulfonate surfactants.** Schechter, R.S.; Wade, W.H.; Weerasooriya, U.; Weerasooriya, V.; Yiv, S. Jan 1985. NTIS, PC A09/MF A01. File Number DE85000112.

In Tertiary oil recovery processes research at the University of Texas. Annual report, October 1981-September 1982.

Isomer-free secondary alkane sulfonates were synthesized from a series of pure secondary alcohols. The C-S bond was formed by thioesterification of the alcohol. A subsequent mild oxidation followed by neutralization generated the monoisomeric sodium sulfonates in good yield. These surfactants were prepared as alternatives to alkane sulfates, which do not have the requisite ther-

mal stability for many high temperature studies and applications. 11 references, 3 figures.

8895 (DOE/BC/10345—2, pp 113-125) **Synthesis and performance of linear monoisomeric ethylene oxide sulfonate surfactants.** Carmona, I.; Schechter, R.S.; Wade, W.H.; Weerasooriya, U.; Weerasooriya, V. Jan 1985. NTIS, PC A09/MF A01. File Number DE85000112.

In Tertiary oil recovery processes research at the University of Texas. Annual report, October 1981-September 1982.

Reaction of sodium bromoethanesulfonate with sodium alkoxides of several linear alcohols produced linear ethylene oxide sulfonates in good yield. These sulfonates were constructed with hydrophobe tails of eighteen and twenty carbons and precisely one, two and three moles of ethylene oxide. All species could be made to produce Winsor III systems with suitable alkane oil phases and the appropriate salt and cosolvent concentrations. 12 references, 3 figures.

8896 (DOE/BC/10476—11) **Vapor pressure studies of the solubilization of hydrocarbons by surfactant micelles. Quarterly report, July 1, 1984-September 30, 1984.** Christian, S.D.; Tucker, E.E. (Oklahoma Univ., Norman (USA)). 1984. Contract AT19-81BC10476. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004319.

The objectives of the project are to obtain accurate thermodynamic information about the solubilization of hydrocarbons and polar derivatives of hydrocarbons by surfactant solutions. Several aqueous surfactant systems, including sodium octylsulfate, sodium octylbenzenesulfonate, and cetylpyridinium chloride, are being investigated with vapor pressure, surface tension, ion activity, and osmometery methods. The extensive analysis of solubilization results for the system sodium octylsulfate/NaCl/benzene/water has been completed, and results summarized in an article to appear in the Journal of Colloid and Interface Science (1). The mathematical analysis of the precise vapor pressure data for this system has been performed to correlate all the results with a mass-action, modified-Poisson distribution model developed in our laboratory. The vapor pressure data for the system at 15, 25, 35, and 45°C are fitted by the model to a root mean square deviation in dissolved benzene concentration of approximately 0.00001 M in each case. Partial pressure of benzene, n-butanol, n-pentanol, and n-hexane have been determined for solutions of cetylpyridinium chloride (CPC) at several CPC concentrations at 25°C. Systems containing an aromatic or alphatic hydrocarbon and a co-surfactant (e.g., an aliphatic alcohol having 4 to 8 carbon atoms) are currently under investigation.

8897 (DOE/ET/10630—T1) **Metal catalyzed reactions of polyaromatic compounds.** Treichel, P.M. (Wisconsin Univ., Madison (USA)). 1978. Contract FG01-77ET10630. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85005220.

Goal is to convert a hydrocarbon raw material into a desired product via metal complex formation. Studies have been carried out on reactions 1 and 2, while work on reaction 3 has not progressed to any extent yet. (DLC)

8898 (DOE/ET/10630—T2) **Metal catalyzed reactions of polyaromatic compounds. Annual progress report.** Treichel, P.M. (Wisconsin Univ., Madison (USA). Dept. of Chemistry). 1978. Contract FG01-77ET10630. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85005219.

Goal is to carry out certain chemical conversions of polyaromatic compounds which can be identified as being promoted by the coordination of a metal. Ideally the problem breaks down into three parts: the formation of metal complexes of suitable aromatic systems; the study of reactions of these complexes; and the displacement or migration step in which the metal group departs its coordination site. To date we have made some headway in meeting the first two parts of this goal. We have synthesized a number of new metal complexes of formulas $[Fe(C_5H_5)(arene)]PF_6$ and $[Ru(C_5H_5)(arene)](PF_6)_2$ for arenes including anthracene, phenanthrene, naphthalene, and substituted naphthalenes, and $M(arene)(CO)_3$ (M = Cr, Mo, W, arene = acenaphthene and acenaphthalene). Preliminary experiments on reactions of certain of these compounds are underway. Most promising appear to be sequences involving reduction of these complexes followed by their reactions as nucleophiles.

8899 (NP—5770036) **Experimental establishment of the diffusion coefficient of the binary liquid mixtures ethanol/water and methanol/water and discussion of its concentration and temperature dependence.** Kircher, K. (Siegen Univ. (Gesamthochschule) (Germany, F.R.). Fachbereich 11 - Maschinentechnik 1). 13 Jun 1983. 142p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number TI85770036.

The diffusion coefficients of the binary liquid mixtures ethanol/water and methanol/water were measured at temperatures between 25°C and 180°C and pressures up to 40 bar. The measurements were carried out over the whole concentration range; the measuring error was +- 3%. The measurements were carried out by means of a diaphragm cell whose membrane system prevents convection due to volume effects during mixing and to temperature variations. The correlation equations presented in earlier publications were validated on the basis of the measured diffusion coefficient. The temperature dependence of the diffusion coefficient was interpreted in terms of Eyring's reaction kinetics.

4004 Electrochemistry

8900 (AD-A—146429/6/XAD) **Electrochemistry in near-critical and supercritical fluids. I. Ammonia. Technical report.** Crooks, R.M.; Fan, F.F.; Bard, A.J. (Texas Univ., Austin (USA). Dept. of Chemistry). 18 Jul 1984. 12p. (TR—1). NTIS, PC A02/MF A01.

Cyclic voltammetric and chronocoulometric studies of NH3 containing 0.1 - 0.2 M KI at T and P up to 160 c and 272 atm are reported. Electrochemical generation of solvated electrons is possible even under supercritical conditions, but their stability is lower at higher T. Reduction of m-chloronitrobenzene (MCNB) to the radical anion yields essentially Nernstian waves from 55 C to 160 C.

8901 (NP—5770150) **Passage of charge through the boundary layer TiO_2-electrolyte.** Schieferdecker, M. (Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Physik). 17 Feb 1983. 164p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE85770150.

Various measuring methods are used to study the transport of charge at the contact TiO_2 - aqueous electrolyte. Dynamic current-voltage characteristic curves at TiO_2 electrodes in O_2-free electrolytes reveal that a voltage dependent charge storage occurs at the phase boundary TiO_2-electrolyte. This can be explained by the existence of surface states. It is possible, by adjustment to the dynamic current-voltage characteristics, to determine the state density and energetics of the surface states with regard to Fermi energy within the semiconductor. The dependence of current-voltage characteristics on electrolyte conductivity, as established from the model system, is confirmed by experiment. The existence of surface states is also demonstrated by the observation of a maximum in measurements of differential capacity. This is based on a model concept whereby in an O_2-free electrolyte the Fermi energy with the TiO_2 regulates the occupation of surface states.

4007 Radiochemistry And Nuclear Chemistry

8902 (KFK—3691) **Report on research and development work 1983 of the Institut fuer Radiochemie.** (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie). Feb 1984. 43p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE85750096.

The Institute of Radiochemistry is concerned with research and development work within the framework of the following projects "Reprocessing and Waste Treatment (PWA)", "Fast Breeder (PSB)", "Nuclear Safeguards (PNS)", "Nuclear material surveillance (PKUe)" and "Nuclear Fusion (PKF)". Fundamental problems arising in the fields of instrumental analysis, in particular surface chemistry and surface structural analysis, and radiochemistry, are dealt with in the work topic "Solid body and Materials

Research". Water technological investigations at IRCH are incorporated in the joint programmes "Technology-Man-Environment". A list of publications and lectures given by members of the Institute during 1983 is provided.

8903 **(RFP—3646) Heat capacity (8 to 350 K) of $PuH_{1.9}$, heat capacity (340 to 600 K) of $PuH_{2.0}$, and recommended thermodynamic properties of PuH_2 to 600 K.** Oetting, F.L.; Hodges, A.E. III; Haschke, J.M.; Flotow, H.E. (Rockwell International Corp., Golden, CO (USA). Energy Systems Group; Argonne National Lab., IL (USA)). 1984. Contract AC04-76DP03533;W-31-109-ENG-38. 29p. NTIS, PC A03. File Number DE85003957.

The low temperature heat capacity of $PuH_{1.9}$(c), where the major plutonium isotope was ^{243}Pu, has been determined from 8 to 350 K. The results of this investigation on $PuH_{1.9}$(c) at 298 K have been adjusted to correspond to the sample composition of PuH_2(c) to give the S^0, Cp^0, and $H^0(T) - H^0(O)$ as 72.94 J K^{-1} mol^{-1}, 43.50 J K^{-1} mol^{-1}, and 8593 J mol^{-1}, respectively, at 298 K. These thermodynamic quantities for PuH_2(c) at 298 K, have been combined with the high-temperature heat capacity data (340 to 600 K) on a sample of $PuH_{2.0}$(c), where the major plutonium isotope was ^{239}Pu, to give the thermodynamic functions of PuH_2(c) over the temperature range from 298 to 600 K. 20 references, 3 figures, 7 tables.

8904 **1-^{11}C-D-Glucose and related compounds.** Shiue, C.Y.; Wolf, A.P. (to Dept. of Energy). US Patent 4,439,414. 27 Mar 1984. Filed date 26 Jan 1982. vp.

PAT-APPL-342684.

The novel compounds 1-^{11}C-D-glucose, 1-^{11}C-D-mannose, 1-^{11}C-D-galactose, 2-^{11}C-D-glucose, 2-^{11}C-D-mannose and 2-^{11}C-D-galactose which can be used in nuclear medicine to monitor the metabolism of glucose and galactose can be rapidly prepared by reaction of the appropriate aldose substrate with an alkali metal ^{11}C-labeled cyanide followed by reduction with a Raney alloy in formic acid.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

REFER ALSO TO CITATION(S) 4008008284, 8763

8905 **(MLM—3215(OP)) Thermal profiles of thermite reactions.** Kelly, M.D.; Abney, L.D. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1984. Contract AC04-76DP00053. 3p. (CONF-8411120—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003308.

From 7. International Society for Optical Engineering meeting on thermosense; Cambridge, MA, USA (5 Nov 1984).

Thermite is a mixture of a metal and oxide which is consolidated to form a composite chemical heat source. Thermal profiles of reacting thermite composites were generated and analyzed to determine the burn rate and the heat propagation during and after the reaction. These thermal profiles are used to establish rates of heat transfer. A time-expanded infrared thermography video will be used to show burn rate, heat propagation, and burn uniformity of consolidated thermite during reaction.

8906 **(MLM—3216(OP)) Infrared thermography of burn front propagation in heat powders.** Kelly, M.D.; Abney, L.D. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1984. Contract AC04-76DP00053. 5p. (CONF-8411120—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003307.

From 7. International Society for Optical Engineering meeting on thermosense; Cambridge, MA, USA (5 Nov 1984).

Heat powders are consolidated into dense composites to form concentrated chemical heat sources. During the reaction, a high temperature burn front propagates through the composites. The burn front is preceded by a lower temperature thermal front which generates thermal gradients. Thermography was used to determine thermal gradients preceding the burn front, during the reaction of the consolidated heat powder. The techniques involved along with the resulting thermography will be discussed.

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4201 General Engineering

REFER ALSO TO CITATION(S) 4201008758

8907 **(EGG-M—24784) Characterization of the heat source distribution of a typical GTAW welding arc.** McIlwain, M.E.; Smartt, H.B.; Stewart, J.A.; Einerson, C.J. (Idaho National Engineering Lab., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 5p. (CONF-8411120—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004322.

From 7. International Society for Optical Engineering meeting on thermosense; Cambridge, MA, USA (5 Nov 1984).

Understanding the influence of fundamental welding parameters on the distribution of the heat flux on the weld and the resulting weld bead morphology has become increasingly important with the escalating emphasis on automated control of the welding process. The arc heat source distribution at the work piece has been studied using the underside infrared signature. Arcs were struck on a thin anode section ranging from 0.5 to 2 mm in thickness. Results from both experiments and calculations suggest that the arc heat input can be readily characterized using the IR thermogram. In addition, other properties such as weld pool cooling characteristics and solidification processes can be determined using this method.

8908 **(RFP—3628) Speed and accuracy in automated manufacture.** Burnham, M.W. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1984. Contract AC04-76DP03533. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003913.

This paper illustrates, with several real manufacturing examples, that speed and accuracy are not necessarily adversary concepts. Rather, in many cases, increased speed results from an improvement in the accuracy of components produced. Thus, the effort to improve accuracy is frequently cost effective and results in an increase in productivity. However, in those cases in which speed and accuracy both improve, new methodology or an over-all view is needed before the improvement is apparent. Some areas used as examples are: accuracy in rolls used in crush dressed form grinding, inspection and assembly time savings, and deep hole drilling.

8909 **(RFP—3726) Effects of SO_2 torch gas additions on GTA weld shape.** Heiple, C.R.; Burgardt, P. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). [1984]. Contract AC04-76DP03533. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004051.

Small additions of sulfur or oxygen to the GTA weld pool in steels with low weld d/w (depth/width) ratios substantially increases the weld d/w ratio and furthermore the improved weld d/w ratio is largely independent of reasonable variations in base metal sulfur and oxygen content. The addition of small concentrations of SO_2 to the normal argon shielding gas is a simple and effective way to add sulfur to the weld pool and increase weld d/w ratio. Autogenous bead-on-plate welds under otherwise identical welding conditions were made on stainless steel plate with SO_2 concentrations in the torch gas ranging between 0 and 2000 ppM.

4202 Facilities And Equipment

REFER ALSO TO CITATION(S) 4202008225, 8226, 8540, 8834, 8835, 8976, 8993, 8998, 9010, 9397, 9408

8910 **(AD—921132/7) Absorption-desorption compressor for spaceborne/airborne cryogenic refrigerators. Final report 1 October 1972-15 January 1974.** Lehrfeld, D.; Boser, O. (Philips Labs., Briarcliff Manor, NY (USA)). Mar 1974. 130p. NTIS, PC A07/MF A01.

The objective of this program was to analytically and experimentally determine the feasibility of using gas sorption processes as the basis for a compressor in a thermally activated aerospace cryogenic refrigeration system. The study involved materials inves-

tigations, development of static compressor design techniques, and the compatability of the static compressor with various refrigeration cycles. Lanthanum-pentanickel ($LaNI_5$) was selected as the most suitable sorbing material because of its large hydrogen storage capability and favorable pressure-temperature characteristics. The ways in which the heat input and $LaNi_5$ mass requirements of a compressor vary with hydrogen flow rate compressor heat capacity, and cycle time were analytically determined and experimentally confirmed. A compressor module designed to deliver 0.015 g/sec at a pressure of 50 atm (and reabsorb hydrogen at a pressure of 4 atm), over a cycle time of 450 seconds, was designed, constructed, and tested. The relative merits of various cryogenic cooling cycles were assessed. For 1 W of cooling at 20-30 K, the absorption compressor combined with a Joule-Thomson cooler was selected for further study. A spaceborne sorption compressor/J-T cooler for producing 1 W at 26 K was approximately sized. The overall system weight and power requirement were estimated to be 278 lbs. and 2.5 kW, respectively. Of the systems selected to produce 2 W at 77 K, none appear to offer any distinct advantages over existing mechanical coolers.

8911 **(ANL—84-75) Flow-induced vibration of the SSME LOX posts.** Chen, S.S.; Jendrzejczyk, J.A. (Argonne National Lab., IL (USA)). Sep 1984. Contract W-31-109-ENG-38. 77p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85004342.

Cracking of liquid-oxygen (LOX) posts was observed in several evaluation tests. The design modification consists of attaching impingement shields to LOX posts in the upstream row. This has improved the vibration/fatigue problem of LOX posts. However, that modification results in an increased pressure drop that ultimately affects the lifetime of other components. This report presents a preliminary assessment of the LOX post vibration problem including a review of relevant parameters, flow induced vibration mechanisms, scoping calculation and experiment, and a work plan for an integrated theoretical/experimental study.

8912 **(FNAL-TM—1116) Pressure analysis of correction coil cryostat.** Larson, E. (Fermi National Accelerator Lab., Batavia, IL (USA)). 28 May 1982. Contract AC02-76CH03000. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003771.

A spool piece cryostat without a correction coil or beam tube was tested for its elastic limit by pressurizing to the onset of nonlinearity in the bulk modulus. (LEW)

8913 **(Juel—1915) Aerosol size characteristics in selected working areas.** Ahmed, K. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Abt. Sicherheit und Strahlenschutz). May 1984. 51p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85750098.

This report presents the work done to study the aerosol activity size distributions and their respirable fractions in some selected areas of the Juelich Nuclear Research Center. Anderson cascade impactors were used to find the aerodynamic size ranges of the airborne particles for subsequent analysis of activity associated with each size group. The aerosols were found to follow in general log-normal distributions in the hot cells with values of AMAD between 5 and 10 μm. Measurements in the AVR containment and decontamination laboratory in Uranit GmbH showed deviations from log-normal distribution. In the waste press area the distribution is sometimes log-normal and sometimes not, depending upon the origin of waste. The values of AMAD are in the range of 2 to 4 μm in these areas. The respirable fractions were calculated using ACGIH definition for respirable dust to be $< 25\%$ in hot cells and $< 60\%$ in other areas. Pulmonary depositions according to ICRP model were $< 10\%$ and $< 15\%$ respectively.

8914 **(K/D—5599) Field modal testing and evaluation of modifications for bridge crane structures designed for sensitive equipment.** Strunk, W.D.; Van Hoy, B.W. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Sep 1984. Contract AC05-84OT21400. 13p. (CONF-850118—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017413.

From 3. international modal analysis conference; Orlando, FL, USA (28 Jan 1985).

Large overhead bridge cranes in particular facilities at the Department of Energy (DOE) uranium enrichment plants are required to exhibit severly restricted vibration levels over a limited frequency range to prevent damage to payloads of sensitive equipment. The large span and unique payload grapple/rotation mechanisms of the crane presented complex challenges in the analysis and solution of excessive payload vibration levels. The problems characterized and solved included (1) testing of heavily damped structural components and massive in-situ structures with high modal density carrying dynamically sensitive payloads; (2) work in poorly accessible locations on is-use equipment within a limited time frame; (3) assessing test results and proposing structural modifications; and (4) qualifications of modifications. Methodology for the test consisted of taking frequency response function (FRF) data (using two techniques) for the crane components and payload, analyzing the data to characterize the components and identify component problems, assessing probable damage versus the rigorous crane performance specification, recommend structural modifications, and verifying the fitness of the modifications. The verification testing demonstrated the success of the crane modifications for maintaining vibration levels within the specification limits by reducing the levels to less than 50% of that allowable.

8915 **(LA-UR—84-2911) Investigation of the time history and modal responses of some simple linear and nonlinear systems.** Hunter, N.F. Jr. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 10p. (CONF-850118—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85002027.

From 3. international modal analysis conference; Orlando, FL, USA (28 Jan 1985).

This paper describes the results obtained from the numerical analysis of some simple (1 to 4 degree of freedom) linear and nonlinear systems. The systems are excited by force or acceleration impulsive loading and the acceleration responses are observed in both the time and frequency domains. The types of nonlinearities include gaps or dead zones, bilinear springs, and hysteretic springs or sliding joints. Characteristic results for these systems indicate that proceeding with a circle fit type modal analysis based on the assumption that the system is linear will indeed allow fitting of a modal circle to what appear to be modes in the system response. These pseudomodes will, however, be of little use in predicting overall system responses to other than the exitation used in the modal measurement. Typical response patterns of the nonlinear systems studied are summarized in the conclusion of the paper.

8916 **(NP—5770060) Plastic design of circular rings as possibility of energy dissipation at ruptures of high energy pipelines.** Kremer, S. (Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Maschinenbau). 5 Dec 1983. 113p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number TI85770060.

In this thesis, the possibility of using plastically deformable rings as components of pipe deflection prevention devices is discussed. The intention is not that constructional details should occupy the foreground, but rather that the possibility of analysing the circular rings together with the broken pipeline should be examined. The aim is to analyse this complex problem into physically apparent and interpretable parts, and to work out suitable partial solutions in analytical form according to the importance of their effect. Simplifications and assumptions are necessary at several places, which go beyond the normal conventions of linear theory. The solutions for the individual partial problems are verified by suitable experiments and at some places by additional comparative calculations based on the method of finite elements. These should provide information on whether and to what degree the results correspond to the actual behaviour of the component.

8917 **(ORNL/Sub—81-95013/1) Reluctance and doubly-excited reluctance motors.** Heyne, C.J.; El-Antably, A.M. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). Nov 1984. Contract AC05-84OR21400. 153p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85003585.

Since the energy crisis in 1974, there has been increasing awareness of conserving energy. Industrial ac motors from 1 to 125

hp are estimated to consume 60% of the total electricity produced in the United States. Significant energy conservation could be achieved if the efficiency of these motors is improved. The work described in this report was sponsored by the Division of Electric Energy Systems (EES) of the United States Department of Energy (DOE) through a subcontract with the Power Systems Technology Program at the Oak Ridge National Laboratory (Oak Ridge, Tennessee, USA). This work deals with the design, analysis, and test of two types of motors designed to have a high efficiency and power factor. The first type, reluctance motors (RMs), are similar to synchronous motors but without dc excitation. A novel 3-phase RM has been designed and tested, and it was found to have superior efficiency when compared with a similar induction motor.

8918 **(PB—84-229533) Computerized site security monitor and response system. Final report.** Moore, R.T. (National Bureau of Standards, Washington, DC (USA)). 1 Jun 1981. 9p. Pub. in Proceedings of Annual Symposium Role of Behavioral Science in Physical Security (5th), Gaithersburg, MD, June 11-12, 1980, p9-17, 1 Jun 84.

Sponsored in part by Defense Nuclear Agency, Washington, DC. See also PB84-294343.

An integrated, state-of-the-art, computer-based system has been defined to enhance and improve the overall physical security of storage sites for nuclear weapons and materials. It would provide for the interconnection of a distributed network of computers with a survivable, fiber optics communications network. This distributed processing system would monitor and control the various physical security sub-systems on the site, including intrusion alarms and alarm assessment subsystems, access control equipments, deterrent systems. Sensors responsive to meteorological and environmental stimuli are provided to permit the use of correlation techniques to identify certain classes of nuisance alarms. The system is intended to provide timely, accurate and unambiguous information about the site security status or the progress of an attack or intrusion attempt and to provide local security forces with appropriate preprogrammed response initiatives.

8919 **(UCID—20282) Three-dimensional analysis of a T156 tank track pad using NIKE3D.** Gerhard, M.A. (Lawrence Livermore National Lab., CA (USA)). 1 Aug 1984. Contract W-7405-ENG-48. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004127.

We are performing a three-dimensional stress analysis to direct the development of two-dimensional models. We are examining load paths, stress and strain distributions and energy retained by the rubber. We do not intend to develop a general three-dimensional approach to evaluating tank track.

8920 **Method for braze-joining spirally wound tapes to inner walls of heat exchanger tubes.** Garrison, M.E. (to Dept. of Energy). US Patent 4,466,567. 21 Aug 1984. Filed date 3 Sep 1982. vp.

PAT-APPL-414545.

The present invention is directed to a method of fabricating heat exchanger tubes in which twisted tapes are utilized for promoting turbulence and heat transfer. The method of the present invention provides for the brazing of the tapes to the inner walls of the tubes for enhancing heat transfer between the fluid within the conduit and a fluid medium outside of the conduit by conduction through the tape. The braze joint of the present invention is coextensive with the tape over the entire length thereof within the conduit. The practice of the present invention is achieved by placing a filler wire of brazing metal along the tape at a location removed from the side walls and then heating the conduit and tape sufficiently to effect the displacement of the filler metal by wicking to the contact point between the tape and the conduit wall to form a braze joint coextensive with the length of the tape within the conduit. This arrangement provides maximum heat transfer and assures that the tape is in contact with the conduit over the entire common length thereof.

8921 **Apparatus for sectioning demountable semiconductor samples.** Sopori, B.L.; Wolf, A. (to Dept. of Energy). US Patent 4,463,927. 7 Aug 1984. Filed date 24 Feb 1983. vp.

PAT-APPL-469350.

Apparatus for use during polishing and sectioning operations of a ribbon sample is described. The sample holder includes a cylinder having an axially extending sample cavity terminated in a first funnel-shaped opening and a second slot-like opening. A spring-loaded pressure plunger is located adjacent the second opening of the sample cavity for frictional engagement of the sample prior to introduction of a molding medium in the sample cavity. A heat softenable molding medium is inserted in the funnel-shaped opening, to surround the sample. After polishing, the heater is energized to allow draining of the molding medium from the sample cavity. During manual polishing, the second end of the sample holder is inserted in a support ring which provides mechanical support as well as alignment of the sample holder during polishing. A gauge block for measuring the protrusion of a sample beyond the second wall of the holder is also disclosed.

8922 **AC losses of 19-strand subcables for the ANL 3.3 MJ coil.** Kim, S.H.; Dawson, J.W.; McGhee, D.G. (Argonne National Lab., Argonne, IL). pp 939-946 of Advances in cryogenic engineering materials. Vol. 30. Clark, A.F.; Reed, R.P. New York, NY, USA; Plenum Press (1984). (CONF-8308180—).

From 5. international cryogenic materials conference; Colorado Springs, CO, USA (15 Aug 1983).

Designs of multistrand-cable conductors for poloidal field and energy storage coils require low ac losses and cryostability. One way to improve these factors is by compacting or solder filling of the subcables. The 19-strand subcable of the ANL 3.3 MJ coil has been compacted and filled with Sn-50% Pb soft-solder to ensure stable current sharing within the subcable and to improve the mechanical rigidity of the final cable. The purpose of this study is to examine the effects of soldering and cable compacting on the ac losses of the coil and to evaluate the overall cable coupling due to the weakly insulated subcables. From the time constant of the samples and the hysteresis loss measurements of the subcables, it is estimated that approximately 60% of the ac losses of the coil at 6 T/s of the central field are due to the losses within the 19-strand subcable itself. The remaining 40% of the losses seem to come mainly from the coupling among the weakly insulated 19-strand subcables in the final cable. The outer sheath copper wires of the subcable improve the stability of the subcable, especially when it is soldered. It is shown, however, that the ac losses are not increased significantly due to the copper stabilizer.

8923 **An apparatus to determine the heat capacity and thermal conductivity of a material from 1 to 300 K in magnetic fields up to 9 T.** Barclay, J.A.; Cheseborough, R.; McCray, M.; McMillan, D.; Overton, W.C.; Stewart, W.F. (Los Alamos National Laboratory, Los Alamos, NM). pp 425-432 of Advances in cryogenic engineering materials. Vol. 30. Clark, A.F.; Reed, R.P. New York, NY, USA; Plenum Press (1984). (CONF-8308180—).

From 5. international cryogenic materials conference; Colorado Springs, CO, USA (15 Aug 1983).

Magnetic refrigeration is a new technology that potentially offers refrigeration efficiencies above 50% of Carnot, compactness, and high reliability. Central to the development of magnetic refrigerators is the characterization of magnetic working substances. Among the key properties for which data are required are the heat capacity and the thermal conductivity as functions of temperature and magnetic field. Accordingly, the Los Alamos National Laboratory has designed and constructed an apparatus to make measurements of these quantities over the range 1 to 300 K at fields up to 9 T. In this paper, the authors describe the methodology of these measurements, the versatile apparatus for making them, and results on the measurements of GdNi, the first sample measured.

8924 **Welding superalloy sheet for superconducting cable jackets.** Summers, L.T.; Morris, J.W.; Strum, M.J. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA). pp 291-296 of Advances in cryogenic engineering materials. Vol. 30. Clark, A.F.; Reed, R.P. New York, NY, USA; Plenum Press (1984). (CONF-8308180—).

From 5. international cryogenic materials conference; Colorado Springs, CO, USA (15 Aug 1983).

JBK-75, an iron-based superalloy, has been selected for use as the cable jacket material for the Westinghouse magnet of the large coil project. Previous investigations of GTA welds of JBK-75 an its sister alloy, A-286, have shown that age-hardened weld metal has significantly lower yield and tensile strengths than comparable heat-treated base metal. In this investigation of A-286 weldments the undermatching properties are shown to be the result of chemical segregation during weld pool solidification. This chemical segregation results in significant changes in the kinetics of precipitation of the gamma prime hardening. Deformation in the aged weld metal is highly localized and delineates the dendritic microstructure. The observed mechanical properties are caused by the formation of precipitate-free regions located at the dendrite cores. These regions form as the result of titanium segregation during weld pool solidification which yields dendrite cores sufficiently lean in titanium as to prevent nucleation of the hardening phase.

8925 **Magneto-mechanical effects in 304 stainless steels.** Fultz, B.; Chang, G.M.; Kopa, R.; Morris, J.W. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA). pp 253-262 of Advances in cryogenic engineering materials. Vol. 30. Clark, A.F.; Reed, R.P. New York, NY, USA; Plenum Press (1984). (CONF-8308180—).

From 5. international cryogenic materials conference; Colorado Springs, CO, USA (15 Aug 1983).

AISI 304 stainless steels are the most widely used structural alloys in cryogenic service. Recently, 304 stainless steels have been used in superconducting magnet structures for magnetic fusion energy devices. In this paper are reported initial measurements of tensile and fatigue crack growth rate properties of 304 stainless steels exposed to 8 T magnetic fields. From an engineering standpoint, the effects of the magnetic field at 77K were found to be quite small. The work-hardening behavior of 304L is consistent with an increased amount of γ-α' transformation in the presence of the field. It appears that both an increase in the amount of prior cold-work and an increase in the amount of carbon plus nitrogen in this material will cause the transformation to effect more work-hardening which does not contribute to the elongation of the material. Preliminary data show that the effect of the magnetic field on the fatigue crack growth rate is barely measurable, but a decrease in the fatigue crack growth rate is indicated.

4203 Lasers

REFER ALSO TO CITATION(S) 4203008979, 9007

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 4204008504

8926 **(IKE—2-66) Theoretical description of film boiling in a two-phase model.** Buerger, M.; Kammerer, E. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme). Dec 1983. 74p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE85750107.

For the description of free convection film boiling on vertical plates, horizontal cylinders and spheres a two phase model was used. For this the boundary layer equations were reduced to systems of ordinary differential equations using a combination of similarity transformations and series expansions. The resulting differential equations were integrated numerically on the CYBER-174 Computer. Also the case of laminar free convection was studied. The results of the calculations performed for a water system are discussed in detail and the comparison with the single phase model was made under the special aspect of the discrepancies between theory and experiment.

8927 **(KFK—3744) Computer-controlled rig for measurements of velocity and turbulence distributions by hot-wires.** Rehme, K. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). Jun 1984. 71p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number TI85750472.

The long measuring times for hot-wire measurements require automation of rig control and data acquisition. The report describes test rig, measurement system and control. The effectiveness was increased by a factor of 60 by computer-control.

8928 **(LA-UR—84-3651) Natural convection heat transfer between arrays of horizontal cylinders and their enclosure.** Weaver, R.A.; Warrington, R.O. (Los Alamos National Lab., NM (USA); Louisiana Tech Univ., Ruston (USA). Dept. of Mechanial Engineering). 1984. Contract W-7405-ENG-36. 8p. (CONF-841201—22). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003773.

From ASME winter annual meeting; New Orleans, LA, USA (9 Dec 1984).

The natural convection heat transfer between arrays of horizontal, heated cylinders and their isothermal, cooled enclosure was experimentally investigated. Four different cylinder arrays were used: two in-line and two staggered. Four fluids (air, water, 20 cs silicone, and 96% glycerine) were used with Prandtl numbers ranging from 0.705 to 13090.0. There was no significant change in the Nusselt number between isothermal and constant heat flux conditions of the cylinder arrays. The average heat transfer coefficient was most affected by the spacing between cylinders and the total surface area of the cylinder arrays. The enclosure reduced the expected increase in both the average and the local heat transfer coefficients caused by changing the inner body from an in-line arrangement to a staggered arrangement of comparable spacing. An increase in fluid viscosity reduced the influence of the geometric effects.

8929 **(LUTKDH/TKKA—1002-1-48) Adiabatic one- and two-phase flow.** Engman, C. (Tekniska Hoegskolan, Lund (Sweden). Avdelningen foer Apparatteknik). Sep 1983. 76p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. File Number TI85750442.

The basic equations for adiabatic one- and two-phase flow are presented. Different theoretical and empirical models for friction and void fraction are described. That sudden increase in pressure (bang) which can occur in the divergent part of a Laval-nozzle is theoretical examined. Different models of critical flow are described. A computer program has been developed for simulating adiabatic one- and two-phase flow. The program can calculate pressure-, temperature-, quality- and velocity-profiles for flow of watersteam through arbitrary canals. If the pressure at the end of the canal is known the mass flow can be calculated. Necessary input data is the state in the beginning of the canal. Friction and void fraction are calculated with different models. The state after a bang and its location are simulated as well. Experimental investigation has been done of the flow through two Laval-nozzles coupled in series. Subcooled water was conveyed to the entrance of the double nozzle and after the first convergent part the water should partially be evaporated. To get better evaporation the first convergent part was replaced by a rose, which had a satisfying result. That big decrease in pressure and temperature that theoretical calculations gives in the following divergent part was not arrived in practice.

8930 **(ORNL/Sub—2975/1) Oscillations in boiling upward flow.** Veziroglu, T.N. (Miami Univ., Coral Gables, FL (USA). Dept. of Mechanical Engineering). May 1968. Contract AC05-84OR21400. 58p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85004419.

It is proposed that two-channel boiling upward flow instability experiments, using Freon-11 as the test fluid, be continued. In the experiments, inlet restriction to each channel, heat input to each channel, and flow rate in each channel are being varied, and their effects on the instability are being studied. After the series of experiments with Freon-11 are completed, a similar series of experiments using distilled water as the test fluid will be carried out. This will make it possible to study the effect of fluid properties on the two-channel two-phase flow oscillations. In parallel with the experimental work, the analytical study will be continued with the aim of obtaining a unified theory of two-phase flow oscillations in a single channel upward flow system. It is hoped to refine the theory by incorporating the slip effects. It is thought this will result in a theory in better agreement with the experimental results. Then, the

analytical study will be extended to two-channel boiling upward flow systems. The goal of this work will be to develop a theory in quantitative agreement with the experimental results for predicting the conditions at the onset of instabilities.

8931 **(ORNL/Sub—2975/2) Boiling upward flow instabilities. Final report.** Veziroglu, T.N.; Lee, S.S. (Miami Univ., Coral Gables, FL (USA). Dept. of Mechanical Engineering). Jul 1968. Contract AC05-84OR21400. 67p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85004426.

The instabilities in single-channel and two-channel forced-convection boiling upward flow systems have been investigated experimentally and analytically. The experimental results show that (1) boiling water flows are less stable than boiling Freon-11 flows, and (2) two-channel systems are more stable than single-channel systems. The analytical study of the density-wave type oscillations in single-channel systems reproduces the general characteristics of this oscillation and predicts the time periods at instability onset with good accuracy.

8932 **(ORNL/Sub—2975/3) Boiling flow instabilities in a two parallel channel upflow system. Final report.** Veziroglu, T.N.; Lee, S.S. (Miami Univ., Coral Gables, FL (USA). Dept. of Mechanical Engineering). Jun 1969. Contract AC05-84OR21400. 79p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85004417.

The instabilities in a two parallel channel forced-convection boiling upward flow system have been investigated using Freon-11 as the test fluid. Two major modes of oscillations, similar to those encountered in single channel boiling flows, have been identified. The first, the density-wave mode, occurs with relatively high exit vapor fractions for one or both of the channels, and also when the working fluid is completely evaporated and superheated. The second, the pressure-drop mode, occurs when the pressure drop across the test section decreases with increasing flow rate and the exit vapor fraction for one of the channels is low. Whenever both of the criteria are met, the two modes of oscillation are found to be superimposed on each other. The system could be stabilized by introducing pressure drop(s) at heater inlet(s) of either channel or both channels. An analytical study has been made of the pressure-drop oscillations by linearizing the governing equations and using Routh's criterion. The conditions for occurrence of these oscillations are predicted by the theoretical analysis.

8933 **(ORNL/Sub—2975/4) Sustained and transient boiling flow instabilities in a cross-connected parallel channel upflow system. Final report.** Veziroglu, T.N.; Lee, S.S. (Miami Univ., Coral Gables, FL (USA). Dept. of Mechanical Engineering). Jul 1971. Contract AC05-84OR21400. 88p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85004429.

Two kinds of instabilities, viz., sustained instabilities and transient instabilities, have been investigated in a cross-connected parallel channel forced convection boiling upflow system. In the investigation of the sustained instabilities, distilled water has been used as the test fluid, and the heat inputs, heat input distributions, mass flow rates, inlet temperatures and inlet valve settings have been taken as variables. Two major modes of oscillation, viz., the density-wave oscillations and the pressure-drop oscillations, similar to those encountered in single channel boiling water flows and in single and parallel channel (with and without cross-connections) boiling Freon-11 flows, have been identified. In the high heat input experiments, in most instances, some temperature oscillations have been observed at the downstream ends of the heaters. The system could not be completely stabilized by introducing pressure drop(s) at the two heater inlets or at the upstream side of the inlet plenum. However, the introduction of inlet pressure drops reduced the amplitudes of the oscillations. The results have been compared with those of the Freon-11 two phase flow experiments in a cross-connected parallel channel system and the water two-phase flow experiments in a single channel system. In investigating the transient instabilities, Freon-11 has been used as the test fluid since it has the advantages of low boiling point and low burn-out heat flux, permitting operations up into the film boiling region. In the experiments, step changes in heat inputs or flow rates have been applied, and the resulting transients in flow parameters have been recorded. The step increases in heat inputs and the step decreases in flow rates have both produced changes in flow rates, pressures and heater wall temperatures. The greater the step change, the greater has been the decrease in flow rates and the increase in heater wall temperatures.

8934 **Verification of a numerical simulation technique for natural convection.** Gadyil, A.; Altmayer, E.; Bauman, F.; Kammerud, R.C. (Passive Research and Development Group, Lawrence Berkeley Laboratory, University of California, Berkeley, CA). *Journal of Solar Energy Engineering;* **106**: No. 3, 366-370(Aug 1984).

4205 Materials Testing

REFER ALSO TO CITATION(S) 4205008766, 8800, 8836, 8850, 8912

8935 **(EGG-M—14484) Effects of scatterer spacing statistics on ultrasonic backscatter signal spectra.** Telschow, K.L.; Lassahn, G.D. (EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 5p. (CONF-8411119—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003259.

From IEEE ultrasonics symposium; Dallas, TX, USA (14 Nov 1984).

The spectrum of an ultrasonic signal backscattered from grain boundaries within a material depends not only on the characteristics of the individual scattering centers but also on the statistical distribution of the distances between neighboring scatterers. Changes in scatterer spacing can cause large changes in the ultrasonic backscatter signal and complicate the interpretation of the signal spectra. This paper illustrates these effects and gives some examples of representative scatterer spacing distributions encountered in the nondestructive estimation of grain size in metals.

8936 **(FNAL-TM—1172) Relative reflectivity of various black paints.** Kerns, C.; Owen, D.; Raymond, A.; Pordes, S. (Fermi National Accelerator Lab., Batavia, IL (USA)). Mar 1983. Contract AC02-76CH03000. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004247.

8937 **(UCRL—50025-84-3) Electronics Engineering Department: EE technical review.** (Lawrence Livermore National Lab., CA (USA)). Nov 1984. Contract W-7405-ENG-48. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004360.

Brief summaries are given of electronics engineering work in the areas of: an automated ultrasonic test bed, design and operation of an ion-cyclotron radio frequency system for the TMX-U, high-speed solid state switches, and polarizing holographic reflector for electron cyclotron resonant heating on the Tandem Mirror Experiment Upgrade. (LEW)

8938 **Method and apparatus for generating a natural crack.** Fulton, F.J.; Holman, W.R.; Honodel, C.A.; Weingart, R.C. (to Dept. of Energy). US Patent 4,453,423. 12 Jun 1984. Filed date 6 May 1982. vp.

PAT-APPL-375645.

A method and apparatus for generating a measurable natural crack includes forming a primary notch in the surface of a solid material. A non-sustained single pressure pulse is then generated in the vicinity of the primary notch, resulting in the formation of a shock wave which travels through the material. The shock wave creates a measurable natural crack within the material which extends from the primary notch. The natural crack formed possesses predictable geometry, location and orientation.

8939 **Pulsed magnetic field testing of multifilamentary Nb_3Sn superconducting wire.** Glazer, J.; Dietderich, D.R.; Morris, J.W. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA). pp 961-968 of Advances in cryogenic engineering materials. Vol. 30. Clark, A.F.; Reed, R.P. New York, NY, USA; Plenum Press (1984). (CONF-8308180—).

From 5. international cryogenic materials conference; Colorado Springs, CO, USA (15 Aug 1983).

Critical current density as a function of applied field is the key design criterion for many applications of superconducting wire. The relationship between the critical current and the applied field may be determined by fixing either parameter while varying the other. Pulsed field testing employs a fixed current and a rapidly increasing field that eventually exceeds the critical field for that current, while steady field testing uses a fixed field and a slowly increasing current. The present work was undertaken to investigate the reliability of pulsed magnet data. The principal objective was not to find a replacement for steady field testing at fields below 20 T, but rather to determine the feasibility of using pulsed magnet data for screening prior to steady field testing. Consequently, the goal was to determine whether pulsed magnet data were accurate in a qualitative sense and, if possible, to identify the likely magnitude and direction of any differences from the steady field data. The work confirms that, at a minimum, pulsed field magnets may be used to obtain preliminary qualitative results about superconducting samples. Although the quantitative critical current data are not as reliable as that obtained under steady fields, at high fields there is good agreement between the data. Because of the many factors that may play a role, explanation of the degraded critical currents found under pulsed fields at lower applied fields is difficult.

8940 **Nondestructive evaluation of thick austenitic stainless steel weldments by shear horizontal acoustic waves.** Schramm, R.E.; Fortunko, C.M.; Moulder, J.C. (National Bureau of Standards, Boulder, CO). pp 119-126 of Advances in cryogenic engineering materials. Vol. 30. Clark, A.F.; Reed, B.P. New York, NY, USA; Plenum Press (1984). (CONF-8308180—).

From 5. international cryogenic materials conference; Colorado Springs, CO, USA (15 Aug 1983).

In this paper the authors describe an automated ultrasonic inspection system using electromagnetic acoustic transducers that may be suitable for nondestructive evaluation of thick austenitic stainless steel weldments. The inspection system is based upon a laboratory minicomputer that controls transducer positioning, data acquisition, and digital signal processing to improve flaw detection, dimensioning, and localization. Chief among the digital signal processing techniques incorporated in the system is a synthetic aperture method that combines ultrasonic data from many transducer locations to produce a focusing effect and increase the signal-to-noise ratio. The feasibility of using shear horizontal acoustic waves to inspect stainless steel weldments is illustrated with the results of preliminary measurements on a 304 stainless steel pipe girth weld containing several different weld defects.

4206 Safety Engineering

REFER ALSO TO CITATION(S) 4206008614, 8645

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 4208008494, 8917, 8937, 9022

8941 **(FNAL-TM—1114) Power spool test, TSH-002, SPTF No. 19.** McInturff, A.D. (Fermi National Accelerator Lab., Batavia, IL (USA)). 28 May 1982. Contract AC02-76CH03000. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003772.

The data presented in this Technical Memo will pertain to the operating characteristics of Power Spool TSH-002. This spool had a large number of thermometers built into it. These thermometers monitored most of the thermal characteristics of the 5000 A American Magnetics, Inc. vapor-cooled leads used in this power spool. Operating conditions, such as peak temperatures, ramp and dc lead cooling gas flow requirements, voltage as an indicator of stable conditions (ac and dc) and general voltage characteristics (i.e., amount of ice formed outside of leads vs high-pot voltage) were measured and observed. It was found that previous operating conditions of the power leads influenced the temperature gradients of the leads in certain cases.

8942 **(FNAL-TM—1149) Fastbus backplane impedance.** Haldeman, M. (Fermi National Accelerator Lab., Batavia, IL (USA)). 24 Nov 1982. Contract AC02-76CH03000. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004260.

8943 **(ORNL/Sub—83-51926/1) Millimeter wave dielectric property measurement of gyrotron window materials. Technical report, January 26, 1983-February 29, 1984.** Ho, W.W. (Rockwell International Corp., Thousand Oaks, CA (USA). Science Center). Apr 1984. Contract AC05-84OR21400. 55p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85004430.

The objectives of this program are to determine the millimeter wave dielectric properties of various single crystal and ceramic materials and coolant fluids in order to assess their transmission properties for high power Gyrotron window applications. Chemical and microstructural analysis are carried out for identifying the key material parameters controlling the millimeter absorption in these materials in support of future advanced materials development efforts.

8944 **(SAND—84-1796) Analytic theory of the backward wave oscillator: dispersion characteristics.** Swegle, J.A. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1984. Contract AC04-76DP00789. 81p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85004149.

Recent experiments with high power microwave generation in backward wave oscillators have employed annular relativistic electron beams and slow wave structures consisting of cylindrical waveguides with a sinusoidally perturbed wall radius. A linearized theory of the dispersion characteristics for these systems is presented here. The theory is valid for beams that are thin in radial extent, axial magnetic fields that are large, and structures that are many ripple periods in length. The dispersion relation at the heart of this analysis is three dimensional. Solutions for the frequency passbands in cold structures with no beam are given, and the full dispersion relation including beam effects is analyzed to determine the effect of varying system parameters on the frequencies and growth rates of the instabilities that lead to microwave production.

4209 Waste Processing Plants And Equipment

REFER ALSO TO CITATION(S) 4209008884

4210 Combustion Systems

REFER ALSO TO CITATION(S) 4210008763

8945 **(AD-A—13469-1) Laser diagnostic development and measurement and modeling of turbulent flowfields of jets and wakes. Part I. Two-dimensional laser doppler anemometer studies of isothermal flowfield in a ducted centerbody combustor. Final report, 1 April 1978-30 September 1982.** Lightman, A.J.; Magill, P.D.; Andrews, R.J. (Dayton Univ., OH (USA). Research Inst.). Jun 1983. 138p. (AFWAL-TR—83-2044-Pt.1). NTIS, PC A07. File Number TI84901885.

A two-dimensional Laser Doppler Anemometer (LDA), using polarization to discriminate between the components, has been constructed and used to measure flowfields in a ducted coaxial jet system with a centerbody. The flowfields studied included central jet only, annular jet only, and combined central and annular jets. In all cases the central jet was CO_2 and the annular jet was air.

8946 **(KC—83/01d) Investigation on boiler corrosion on flue gas side during lay-up. Investigation of critical humidity and shunt temperature.** Jensen, T.; Jansen, P. (Korrosionscentralen, Glostrup (Denmark)). 1983. 36p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85750398.

Laboratory tests were accomplished in order to determine relatonships between boiler temperature, air humidity and corrosion rate on the flue gas side in a district heating boiler during lay-up.

Corrosion rate was measured for various iron types with iron sulfate deposits either sampled in boilers or prepared of $FeSO_4.H_2O$. The critical relative air humidity for iron with boiler deposit was determined as Fi similar with 0.46 or Fi similar with 0.40 for deposit containing $FeCl_3$. The critical boiler temperature is given as a function of air temperature and relative humidity. This temperature is in Denmark practically always under 40degC.

8947 **(PB—84-233816) Effect of ageing on the interfacial structures of nickel-based transition joints.** Nicholson, R.D. (Central Electricity Generating Board, Southampton (UK). Technology Planning and Research Div.). 1982. 40p. (TC—358). NTIS, PC E04/MF E04.

The superheater and reheater sections of coal-fired boilers are fabricated from austenitic and low-alloy ferritic steels. The material choice is determined by economic and metallurgical factors and results in the need for welded joints between the austenitic and ferritic materials. Typically, they are made using either austenitic stainless steel or nickel-based weld metals. Service experience with transition joints suggest that nickel-based joints give better performance than the austenitic weld metal joints. However, no joint can be guaranteed for 200,000 hours service and currently there are no methods available for predicting the life of existing joints. In this report the conditions for acceleration are described together with the problems encountered by attempting over-acceleration. The precipitate types, sizes and morphologies produced by the acceleration treatment are compared with those resulting from actual long term power station service.

8948 **(STF—15A83014) Coal heating district heating plants.** Hustad, J.; Syvertsen, G.; Walde, P. (SINTEF, Trondheim (Norway)). May 1983. 55p. (In Norwegian). NTIS (US Sales Only), PC A04/MF A01. File Number TI85750431.

The Elektrisitetsforsyningens Forskningsinstitutt (EFI) has considered the Norwegian district heating potential. The remaining demand is 7 TWh and parts of it may be covered by coal when local energy resources are utilized to a reasonalble extent. Two plant constructions are outlined for different capacities. A simple and dependable coal using a central heater is outlined based on experiences from market gardens and traditional heating engineering. A new type of combustion system, fluidized bed, is a quite good alternative to coal using central heating systems due to its fuel flexibility and favourable environmental qualities. In Denmark, Finland and Sweden, district heating development is of great importance. About the year 2000, the total energy supply is expected to be round 140 TWh, of which the half will be based on coal. 8 drawings, 9 tables.

8949 **(STF—15A83031) Practical experience from coal using boilers - underfeedstokers.** Hustad, J.; Utne, Aa. (SINTEF, Trondheim (Norway)). Jun 1983. 35p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. File Number TI85750432.

The report comprises one year operational experience of coal using boilers as heaters for greenhouses at three market gardens in Lier (Norway). The experiences are based on technical inspections and combustion measurements on the plants and also conversations with consultants and gardeners. The economical results are good and the time of repayment is at best 13 months. The technical combustion results, concerning two of the boilers, are very good and the efficiencies are up to 85-86%. The measured results have lead to recommendations about suitable coal qualities and the most favourable operating conditions of the plants. Experiences of the coal transport systems are mostly good but some components proved unsuitable for coal transport. 6 drawings, 6 tables.

4220 Underground Engineering

8950 **(DOE/NV/10327—2) Emplacement hole drilling, Nevada Test Site, Fiscal Year 1983.** Dean, R. (Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA)). Dec 1983. Contract AC08-84NV10327. 31p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85003968.

Reynolds Electrical and Engineering Co., Inc. (REECo) completed twenty-three emplacement holes (including one abandoned hole) in Fiscal Year 1983. Six of the surface conductors were set in a prior year, as shown on Table 1. Thirteen holes (including two on the Pahute Mesa) were drilled for the Lawrence Livermore National Laboratory (LLNL). Ten emplacement holes (including two on the Pahute Mesa) were drilled for the Los Alamos National Laboratory (LANL). Emplacement drilling at the Nevada Test Site in Fiscal Year 1983 consisted of 32.4 rig weeks for LLNL at a total cost of $7,176,000 and 42.6 rig weeks for Los Alamos at a total cost of $10,732,000. However, data in this report are limited to the emplacement holes completed in Fiscal Year 1983. For emplacement holes completed during the past two fiscal years, the average cost per foot drilled (below the surface conductor) are summarized. The average unit cost per foot drilled includes logging, sampling, casing, and cementing plus costs incurred for any remedial work or fishing. The Halliburton Maintenance of Capability (MOC) costs for LLNL are charged to Emplacement Drilling Support work orders. For Los Alamos, these MOC costs are charged to Site Preparation Drilling and Zero Station Drilling work orders. Excluding these costs, the average cost per foot for Los Alamos in Fiscal Year 1983 would be $426.67 (uncased holes), $681.68 (lined holes) and $756.17 (Pahute holes). The footage drilled per rig day has increased in recent years. Data on penetration rates and cost per foot are shown. Data in this report reflect charges to separate work orders, Site Preparation Drilling and Zero Station Drilling for each emplacement hole.

8951 **(DOE/NV/10327—3) Postshot drilling, Nevada Test Site, Fiscal Year 1983.** Dean, R. (Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA)). Dec 1983. Contract AC08-84NV10327. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003930.

This report is a compilation of operational and cost data for the 16 drillbacks completed during Fiscal Year 1983. Its purpose is to summarize major elements of costs in significant categories and to show their relative contribution to total costs. Productivity data and cost summaries for Fiscal Years 1977 through 1983 are included in the report to indicate any trends in each laboratory's postshot drilling practices and costs. Current postshot drilling practices include setting 13-3/8-inch conductor pipe for the Los Alamos National Laboratory (LANL) holes and 10-3/4-inch conductor pipe for Lawrence Livermore National Laboratory (LLNL) holes. Both laboratories utilize 9-7/8-inch bits for postshot drilling. The Los Alamos program uses the Skytop drill rig to drill both angle and directional holes that are deeper than 1200 feet. For holes 1200 feet deep or less, Los Alamos uses the Boyles drill rig. Angle holes for LLNL are drilled with the Hycalog drill rig and directional holes are drilled with either the BIR 800 or the Ideco 525 drill rig. Air foam and sepiolite mud are used on postshot holes for LLNL events and bentonite mud or sepiolite mud are used on holes for Los Alamos events. Sepiolite mud is now favored over bentonite mud in hole conditioning at depth. During Fiscal Year 1983, the costs of plugging old (prior to FY 1983) postshot holes near event locations were $114,656 for LLNL and $5,833 for Los Alamos. These costs are charged to separate work orders and were not used in determining postshot drilling costs. Costs incurred for general construction support of postshot drilling is not directly comparable for LLNL and Los Alamos because charges for similar tasks are accounted for differently by each laboratory. Containment equipment costs for LLNL and Los Alamos are shown.

4230 Marine Engineering

REFER ALSO TO CITATION(S) 4230008282, 8283

8952 (CONF-8109272—, pp 19-24) **Unconfined vapour cloud explosions. A prestudy.** Pappas, J.; Solberg, D. (Det norske Veritas, Oslo (Norway)). 1981. NTIS (US Sales Only), PC A08/MF A01. File Number TI85750428.

From Safety offshore seminar on fire protection; Bryne, Norway (23 Sep 1981).

The current knowledge (up to 1979) on unvonfined vapour cloud explosions is reviewed in the light of the hazard such an explosion represents especially to offshore installations and with the purpose of identifying the need for future research.

4240 Pollution Control Equipment

REFER ALSO TO CITATION(S) 4240008186, 8187, 8188, 8879, 9054

8953 (NHL—282054) Testing of oil pollution protection equipment north of the Ekofisk field on the 26-30th of April 1982. Nilsen, J.; Noesen, G. (Norges Hydrodynamiske Lab., Trondheim). Jun 1982. 131p. (In Norwegian). (STF—60A82054). NTIS (US Sales Only), MF A01. File Number TI85750437.

In connection with full scale testing of oil pollution protection equipment the Norwegian Hydrodynamic Laboratories was engaged in measuring waves, volume flow in flexible tubes, pressure measurements in the oil collection tank and measuring oil leaks behind the oil booms by aid of light transparency determinations. The tests were carried out north of the Ekofisk field on the 26-30th of April 1982. The results of the wave measurements show that the significant wave height (HS) varied between 1.27 and 1.52 m on the 27th of April 1982 and tests with oil were carried out. When the exercises was closed on the 29th April, HS varied between 3.22 and 4.30 m. The volume flow measurements in the flexible tube showed that the volume current varied strongly in a relatively short period of time. The maximal volume flux was measured to be about 244 tons/ hour. The pressure determinations in the port ballast tank showed collected amount of oil/water. The light determinations carried out at 1.5 m depth about 5 m behind the booms, showed how the oil leaks came in pulses. The maximum determined oil consentration behind the boom was about 141 ppm. 117 tables, 113 drawings.

8954 (SI-R—820804-1) Collection bell which matches a special base plate receptacle. Westergaard, R.H. (Sentralinstitutt for Industriell Forskning, Oslo (Norway)). Nov 1982. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number TI85750435.

The report presents the problems which must be solved and concludes that practical and reliable solutions seem possible within the state of the art. The conclusion is: On single wells which are accessable, the method seems simpler and more likely to succeed than other concepts. If the method is developed, the authorities may make an underwater collection preparedness a precondition for subsea oil production and possible all or some types of exploration and exploitation drilling. This will restrict the selection of technology to systems where the well is accessable and a receptacle on each well is possible. The system is probably simple enough to be implemented on the NCS - even without foreign participation. 1 drawing.

4250 Power Cycles

REFER ALSO TO CITATION(S) 4250008780

43 PARTICLE ACCELERATORS

4301 Design, Development, And Operation

REFER ALSO TO CITATION(S) 4301008607

8955 (FNAL-TM—1112) Beam storage studies in the Fermilab main ring. MacLachlan, J.A. (Fermi National Accelerator Lab., Batavia, IL (USA)). 6 May 1982. Contract AC02-76CH03000. 34p. NTIS, PC A03; 3; GPO Dep. File Number DE85003768.

Bunched beams of 100 and 150 GeV have been stored in the Fermilab Main Ring for periods of up to one hour. The observations of beam current and beam profiles are analyzed for the effects of gas scattering, chromaticity and non-linear magnetic field.

8956 (FNAL-TM—1120) Z80 based voltage and temperature monitor for the Main Ring control crate: the CC48 card. Seino, K. (Fermi National Accelerator Lab., Batavia, IL (USA)). Jun 1982. Contract AC02-76CH03000. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003346.

Several years ago, there seemed to be a need to monitor the power supply voltages and temperatures in the three bay racks of the Main Ring service buildings. A few years ago, another engineer seemed to have done a preliminary design using analog voltage comparators. In late 1979, it was proposed to use a microprocessor instead of analog voltage comparators. It was dramatic that all the people at a meeting were excited about the idea and unanimously approved the project. The author can remember some of the reasons why they were so enthusiastic about the idea at the time, i.e., (1) it was new to have microprocessor based cards on the Main Ring control system, (2) programmable alarm limits were preferred to resistor dividers or potentiometers with analog voltage comparators, (3) it was the first to try the communication between a host computer and distributed intelligent cards. The author started the design on the CC48 in January, 1980 and completed in April, 1980. We had the prototype card working in July, 1980 and tested the card on the system in September, 1980. Seven CC48s of the pilot production were installed in July, 1981. We mass-produced 35 more cards and finished installing them around the Main Ring in May, 1982. The author talks about the hardware, software and operation on the CC48 card, and he will make some remarks on his experience on the project.

8957 (FNAL-TM—1134) Energy saver A-sector power test results. Martin, P.; Flora, R.; Tool, G.; Wolff, D. (Fermi National Accelerator Lab., Batavia, IL (USA)). 15 Sep 1982. Contract AC02-76CH03000. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004277.

The superconducting magnets and associated cryogenic components in A-sector represent the initial phase of installation of the Fermilab superconducting accelerator, designed to accelerate proton beams to energies of 1 TeV. Installation of the magnets, comprising one-eighth of the ring, was completed in December, 1981. Cooldown and power tests took place in the first half of 1982, concurrent with main ring use for 400 GeV high energy physics. The tests described in this paper involved 151 cryogenic components in the tunnel: 94 dipoles, 24 quadrupoles, 25 spool pieces, 3 feed cans, 4 turn-around boxes and 1 bypass. Refrigeration was supplied by three satellite refrigerators, the Central Helium Liquefier, and two compressor buildings. The magnets were powered by a single power supply.

8958 (FNAL-TM—1159) Very high energy synchrotron radiation at Fermilab. Haggerty, J.S. (Fermi National Accelerator Lab., Batavia, IL (USA)). Jan 1983. Contract AC02-76CH03000. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004272.

Synchrotron radiation with energy up to 1 GeV will be produced by an electron beam at the new wide band neutral beam under construction in the Proton Laboratory at Fermilab. The spectrum of the radiation is estimated, and some experiments using it are discussed.

8959 (FNAL-TM—1170) RFSYS: an inventory code for RF system parameters. Treadwell, E.A. (Fermi National Accelerator Lab., Batavia, IL (USA)). Mar 1983. Contract AC02-76CH03000. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004246.

RFSYS is a program which maintains an inventory of rf system parameters associated with the 200 MeV Linear Accelerator at Fermi National Accelerator Laboratory. The program, written by Elliott Treadwell, of the Linac group, offers five modes of operation: (1) Allocates memory space for additional rf systems (data arrays). (2) Prints a total or partial list of old tube parameters on an ADM-3 terminal. (3) Changes tube data stored in the master array. If the number of systems increases, this mode permits the user to enter new data. (4) Computes the average time of operation for a given tube and system. (5) Stops program execution. There is an exit option, (a) create one output data file or (b) create three output files, one of which contains column headers and coded comments. All output files are stored on the CYBER-175 disc, and eventually on high density (6250 B.P.I.) magnetic tapes. This arrangement eliminates the necessity for online data buffers.

8960 **(FNAL-TM—1183) Fermilab Tevatron quadrupoles.** Cooper, W.E.; Fisk, H.E.; Gross, D.A.; Lundy, R.A.; Schmidt, E.E.; Turkot, F. (Fermi National Accelerator Lab., Batavia, IL (USA)). Mar 1983. Contract AC02-76CH03000. 7p. NTIS, PC A02. File Number TI85004254.

Details on the design, construction, and performance tests of Energy Saver/Doubler quadrupoles are presented along with recent data from the test of a special high gradient low beta prototype quadrupole.

8961 **(FNAL-TM—1226) Shape algorithm for a RFQ vane.** Juarez, B.; Treadwell, E. (Fermi National Accelerator Lab., Batavia, IL (USA)). 30 Nov 1983. Contract AC02-76CH03000. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004251.

The Radio Frequency Quadrupole Linear Accelerator (RFQ) proposed by Kapchinskii and Teplyakov, has become an accepted structure in the accelerator community. The first working model was developed at Los Alamos for the 440 MHz cavity, and since then 200 MHz models have appeared at BNL, CERN, LBL, and KEK. The RFQ is very useful bunching low-energy ion beams and accelerating them to sufficient energies for injection into a linear accelerator. A Fermilab model of the RFQ would be a 200 MHz structure capable of accelerating H^- ions from 30 keV to 750 keV in 1.36 meters. The ion current fo 50 mA would be pulsed at 15 Hz. The RFQ vane-tip parameters, m(z) and a(z) are determined along the vanes according to an algorithm developed by K. Crandall et. al. Results of this calculation are stored on paper tape and input into numerically controlled milling for vane cutting. We have used the algorithm to calculate a vane shape for the 200 MHz RFQ and have plotted the results using the Device Independent Graphics System.

8962 **(KEK—81-21) Proceedings of the fourth symposium on machine work of scientific instruments.** Hongo, Toshio (ed.). (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Mar 1982. 32p. (CONF-8110341—). NTIS (US Sales Only), PC A03/MF A01. File Number DE85780123.

From 4. symposium on machine work of scientific instruments; Oho, Ibaraki, Japan (24 Oct 1981).

Abstracts of individual items from the symposium were prepared separately for the data base. (GMT)

8963 **(LA—10277-MS) Design of ferrite-tuned accelerator cavities using perpendicular-biased high-Q ferrites.** Kaspar, K. (Los Alamos National Lab., NM (USA)). Nov 1984. Contract W-7405-ENG-36. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85005196.

Microwave ferrites with dc bias fields perpendicular to the rf fields exhibit magnetic and dielectric quality factors 1 order of magnitude above that of ferrites used in ferrite-tuned synchrotron accelerating cavities built in the past. For the LAMPF II project, these ferrites appear to allow the design of synchrotron cavities with high gap voltages and high efficiency. A simple coaxial quarter-wave-resonator geometry, first considered only as a model for preliminary studies, turned out to be a good basis for the solution of most technical problems such as generation of the bias field, cooling of the ferrites, and installation of a generous high-voltage gap design. Two quarter-wave resonators combined to form one accelerating unit of about 2.5-m length and 0.6-m diameter should be capable of delivering 120 kV of accelerating voltage in the tuning range 50-60 MHz, up to 200 kV in the range 59-60 MHz. The main advantage of the given resonator design is its full rotational symmetry, which allows calculation and optimization of all electrical properties with maximum reliability.

8964 (LBL—18500, pp 8-11) **Accelerator development activities.** Aug 1984. NTIS, PC A04/MF A01. File Number DE85003166.

In Accelerator and Fusion Research Division: summary of activities, 1983.

Accelerator developments are aimed at more efficient use of operating time, higher beam intensities, and more effective charge stripping. Completion of the fast switching program will be a major step toward the first of these goals. The objective is to allow the nuclear science and biomedical programs to share beam time on a very short time scale. This requires flexible and stable systems (permitting reproducible tunes), and an ability to change ion species, energy, and beam line in minutes. Improvements to the detectors and amplifiers at the SuperHILAC are also under way.

8965 (LBL—18500, pp 18-20) **Other aspects of SSC design.** Aug 1984. NTIS, PC A04/MF A01. File Number DE85003166.

In Accelerator and Fusion Research Division: summary of activities, 1983.

In anticipation of a major effort over the next several years to prepare for the SSC, LBL has begun to look at three major accelerator design issues, each related to our magnet design efforts: (a) basic design and parametric studies, (b) accelerator physics and beam dynamics studies, and (c) subsystem and component technology.

8966 **(SLAC-PUB—3508) New timing system for the Stanford Linear Collider.** Paffrath, L.; Bernstein, D.; Kang, H.; Koontz, R.; Leger, G.; Ross, M.; Pierce, W.; Wilmunder, A. (Stanford Linear Accelerator Center, CA (USA)). Nov 1984. Contract AC03-76SF00515. 3p. (CONF-841007—35). NTIS, PC A02. File Number DE85004650.

From Nuclear science symposium; Orlando, FL, USA (31 Oct 1984).

In order to be able to meet the goals of the Stanford Linear Collider, a much more precise timing system had to be implemented. This paper describes the specification and design of this system, and the results obtained from its use on 1/3 of the SLAC linac. The functions of various elements are described, and a programmable delay unit (PDU) is described in detail.

4302 Beam Dynamics, Field Calculations, And Ion Optics

8967 **(BNL—35406) Aperture studies with Patricia and Racetrack on simple lattices containing SSC dipoles.** Dell, G.F.; Leemann, B.; Willeke, F. (Brookhaven National Lab., Upton, NY (USA); Lawrence Berkeley Lab., CA (USA); Fermi National Accelerator Lab., Batavia, IL (USA); Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). 23 Jun 1984. Contract AC02-76CH00016. 6p. (CONF-8406198—25). NTIS, PC A02/MF A01; GPO Dep. File Number DE85004163.

From Design and utilization of the superconducting super collider summer study; Snowmass, CO, USA (23 Jun 1984).

The PATRICIA and RACETRACK particle tracking programs have been compared by tracking on a simple lattice. The dynamic aperture was found to decrease as the number of passes through the lattice per run increased from 20 to ~ 300, and it remained constant for longer runs. The dynamic apertures found by the two programs are consistent. The dependence of the dynamic aperture on horizontal tune near a decapole resonance was investigated. RACETRACK and PATRICIA showed decreases in the aperture on opposite sides of the resonance. A second set of studies was made with PATRICIA in which the dynamic apertures of lattices consisting of cells of the types used for the Reference Designs Study were determined when random multipole errors of the dipoles were included. The dependence of aperture on the number of cells in the lattice was determined. Finally, a comparison of magnet types suggested for the SSC was made by determining the aperture of lattices containing these magnets.

8968 **(BNL—35448) Sample of depolarization resonance correction from the initial commissioning of the polarized beam at the AGS.** Ratner, L.G. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 6p. (CONF-8409162—7). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004158.

From 6. international symposium on high energy spin physics; Marseille, France (12 Sep 1984).

A description of the response to correction for several resonances is presented. Different behavior is seen between resonances of the same class, i.e., either intrinsic or imperfection resonances show

different behavior within their own genre. A brief description of the facility and present status is also given. 10 figures.

8969 **(FNAL-TM—1103) RF stacking and tail cooling in the antiproton accumulator.** Ando, A.; Takayama, K. (Fermi National Accelerator Lab., Batavia, IL (USA)). Apr 1982. Contract AC02-76CH03000. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003349.

We find criteria on the cooling system to minimize effects of RF stacking on the cooling tail.

8970 **(FNAL-TM—1106) Tevatron B0 low beta tuning report.** Johnson, D.E. (Fermi National Accelerator Lab., Batavia, IL (USA)). 5 May 1982. Contract AC02-76CH03000. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003350.

A detailed study of the low beta insertion for the B0 experimental area has been carried out and is described below. This insertion is similar to the Type C low beta previously report, anti p Note 169, although some changes have been made to the quadrupole lengths and positions. This insertion is designated Type E. The purpose of the study was to see if it is possible to turn the insertion on in a smooth and continuous manner and tune the insertion to a value of β^* of less than one meter while maintaining the overall tune of the j Tevatron to a constant value. This was found to be possible. An examination of chromaticity corrections for the Tevatron with the low beta insertion on in various configurations was also undertaken.

8971 **(FNAL-TM—1118) Hysteresis of sextupole and ac loss in Energy Doubler dipole magnets.** Ishibashi, K. (Fermi National Accelerator Lab., Batavia, IL (USA)). 18 Jun 1982. Contract AC02-76CH03000. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003344.

A simple model gave utilized for calculation of magnetization effects on ac loss and sextupole for Energy Doubler dipole magnets. The calculation in the simple model gave an underestimation of ac loss by about 30%. Results of computation on ac harmonics were also described.

8972 **(FNAL-TM—1137) Proton therapy nozzles design and analysis.** Kramer, S.L. (Fermi National Accelerator Lab., Batavia, IL (USA)). Sep 1982. Contract AC02-76CH03000. 18p. NTIS, PC A02/MF 01; 1; GPO Dep. File Number DE85004278.

Beams from high energy accelerators are constrained to have very small emittances. To be useful for large volume proton therapy they must be spread out in space to illuminate the entrance portal uniformly. This could be done by letting the beam diverge (either from its own angular spread or by defocusing it with quadrupoles) and then collimating the beam to a uniformity of the spatial density of particles to yield the required dose uniformity. However, this technique is very inefficient on the use of incident beam. Although scanning the beam magnetically could yield high efficiency and highly uniform dose, considerable development would be necessary to develop the technique and its required reliability. The use of multiple scattering foils simplifies the treatment planning and verification, since the size and uniformity are determined only by the properties of the materials and not by the variables (current, temperature, hysteresis, etc.) in magnetic scanning devices.

8973 **(FNAL-TM—1153) Dynamics of RF captured cooled proton beams.** Kells, W.; Mills, F. (Fermi National Accelerator Lab., Batavia, IL (USA)). Jan 1983. Contract AC02-76CH03000. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004268.

In the course of electron cooling experiments at the Electron Cooling Ring (ECR) at Fermilab, several peculiar features of the longitudinal phase space of cold protons (200 MeV) captured in RF buckets were observed. Here we present the experimental facts, present a simple theory, and summarize computer simulation results which support the theory and facts.

8974 **(FNAL-TM—1220) Study of the tevatron nonlinear acceptance by computer simulation.** Willeke, F. (Fermi National Accelerator Lab., Batavia, IL (USA)). 1 Nov 1983. Contract AC02-76CH03000. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004245.

In this report, the results of computer calculations of nonlinear acceptance reduction caused by nonlinear fields in the TEVATRON are presented. A set of test particles has been traced during many revolutions in the accelerator in order to determine the maximum stable amplitude in the presence of nonlinear fields. Sources of nonlinear fields are designed imperfections of dipole and quadrupole magnets, fluctuations due to manufacturing tolerances, and sextupole fields needed to compensate for chromaticity.

8975 **(LA-UR—84-3526) Effect of magnet error on slow extraction.** Colton, E.P. (Los Alamos National Lab., NM (USA)). Jun 1984. Contract W-7405-ENG-36. 3p. (CONF-8406198—24). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003749.

From Design and utilization of the superconducting super collider summer study; Snowmass, CO, USA (23 Jun 1984).

We calculate analytically the expected tune shifts due to systematic sextupole and decapole errors in the SSC dipoles of reference design A at an energy of 20 TeV. The momentum-dependent tune shift due to sextupole error is d nu/sub x/ = -0.0557 for $\Delta p/p = +\text{-}2 \times 10^{-5}$. The random sextupole component in the SSC dipoles Δb_2 should be less than 5×10^{-4}.

8976 (LBL—18500, pp 15-18) **Superconducting magnets.** Aug 1984. NTIS, PC A04/MF A01. File Number DE85003166.

In Accelerator and Fusion Research Division: summary of activities, 1983.

Several 1-meter prototype magnets were tested in 1983, each embodying different design concepts. Some of the developments being pursued in the quest for higher field strengths are windings of Nb_3Sn conductor, smaller bore diameters, smaller copper-to-conductor ratios, optimized coil configurations, and operation of Nb-Ti-wound magnets at 1.8 K. Among our achievements during the year was an accelerator-type magnet producing a record field of 8.8 T. With an eye to reliability, economy, and field uniformity, we proposed at year's end a two-in-one SSC magnet design based on the well-characterized Nb-Ti conductor that would produce a central field strength of 6.5 T at 4.5 K.

8977 (LBL—18500, pp 20-21) **Beam cooling.** Aug 1984. NTIS, PC A04/MF A01. File Number DE85003166.

In Accelerator and Fusion Research Division: summary of activities, 1983.

The technique of stochastic cooling is applicable to particles such as antiprotons circulating in a ring. Sensitive electrodes are needed to pick up from each passing particle the tiny signal indicating its deviation from the mean transverse position and velocity of the beam. That signal is then amplified and transmitted downstream by fast electronics to a kicker electrode, where it is applied as a corrective impulse to the same particle. The development, production, and testing of components for stochastic cooling of antiprotons is being carried out in support of the Tevatron proton-antiproton collider project at Fermilab. In addition, we are beginning to pursue improvements in this technology and its more general application to feedback systems in the SSC.

8978 **(SLAC-PUB—3472) Review of polarized proton beam techniques and a report on the workshop on polarized beams.** Ruth, R.D. (Stanford Linear Accelerator Center, CA (USA)). Oct 1984. Contract AC03-76SF00515. 15p. (CONF-8409162—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004390.

From 6. international symposium on high energy spin physics; Marseille, France (12 Sep 1984).

This paper first introduces the basic techniques for polarized proton beams: spin flip, resonance jumps, Siberian Snakes, etc., and then concludes with a report on the Workshop on Acceleration and Storage of Polarized Protons and Electrons in Very Large Machines. 25 references, 5 figures, 2 tables.

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 4303008944, 9021

8979 (BNL—35444) Construction tolerances for low loss, dielectric coated, metallic waveguide for transmission optical radiation. Sandweiss, J. (Brookhaven National Lab., Upton, NY (USA); Yale Univ., New Haven, CT (USA). Dept. of Physics). Aug 1984. Contract AC02-76CH00016. 20p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004056.

The transmission of radiation, in a specific mode of interest for the IFELA, past a symmetric step in dielectric coating thickness has been calculated. The result shows that the transmission loss depends on the quantity $(s/D)^2$ and vanishes to first order in the ratio of the step s to the guide aperture D. With the reasonable assumption that this feature holds for all forms of surface imperfections, the attenuation length due to imperfections has been estimated. It is found that rms surface roughness of $\sim 0.1\ \mu$ m leads to attenuation lengths of 25 km or greater.

8980 (FNAL-TM—1100) Structural analysis of the CDF Central Calorimeter Cradle Assembly. Leininger, M. (Fermi National Accelerator Lab., Batavia, IL (USA)). Apr 1982. Contract AC02-76CH03000. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003348.

Hand calculations made so far on the Central Calorimeter Cradle Assembly are compared with stress and displacement solutions obtained using ANSYS.

8981 (FNAL-TM—1105) Expanded Fermilab pressure vessel directory program. Tanner, A. (Fermi National Accelerator Lab., Batavia, IL (USA)). Jan 1983. Contract AC02-76CH03000. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003347.

Several procedures have been written to manage the information pertaining to the vacuum tanks and pressure vessels for which the laboratory is responsible. These procedures have been named TANK1 for the vessels belonging to the Accelerator Division, TANK2 and TANK3 for the vessels belonging to the Research Division and to Technical Support respectively, and TANK4 for the vessels belonging to the Business Division. The operating procedures are otherwise identical in every respect.

8982 (FNAL-TM—1117) CASIM predictions of Meson West Tevatron target soil activation. Gronemeyer, S.A. (Fermi National Accelerator Lab., Batavia, IL (USA)). 21 Jun 1982. Contract AC02-76CH03000. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003770.

A new Meson West Target has been proposed for Tevatron II. The dump design proposed by David Eartly is shown. A longitudinal side view of the dump and the shield for target produced muons is shown. The core of the dump is seen to be a copper plate surrounding the beam. The copper is surrounded by iron, which is in turn shielded by concrete. The tunnel is embedded in sand and gravel. The sand and gravel within 3' of the concrete is continuously drained by underdrains. Soil below the top of the underdrains is not considered to be protected. Activity produced in the unprotected soil below can be leached out, transported to the aquifer, and subsequently reach public water supplies. It is the activation of this unprotected soil which is of particular interest. Since the specific type of beryllium target to be used has not yet been decided, and since it would only reduce the resultant soil activation, I have chosen to ignore it and to presume that all the targetted intensity is lost on the dump. I have made CASIM calculations of the levels of soil activation to be expected using the proposed dump design. Since the activation of the unprotected soil is the major consideration, I made the calculations using rectangular geometry (rather than the usual cylindrical approximation). To improve the statistics of my results, I reflect the lower half through the horizontal plane passing through the beam and divide the result by 2.

8983 (FNAL-TM—1119) Compensation of the solenoid field in the colliding-beams detector. Teng, L.C. (Fermi National Accelerator Lab., Batavia, IL (USA)). 4 Jun 1982. Contract AC02-76CH03000. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003345.

There is no need to provide individual compensation for the detector solenoid. The correction skew quads which correct for the skew quad errors should take care of the detector solenoid. (GHT)

8984 (FNAL-TM—1121) Performance testing of super Fe magnet. McInturff, A.D. (Fermi National Accelerator Lab., Batavia, IL (USA)). 30 Jun 1982. Contract AC02-76CH03000. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004261.

A summary is given of the data obtained during the testing of a proof of principle iron-dominated low field and cost, high efficiency dipole. The magnet was tested for performance with the design field of 2.0T.

8985 (FNAL-TM—1122) Construction of a Fermilab superferric test magnet. Heim, J.; Hinterberger, H.; Jagger, J. (Fermi National Accelerator Lab., Batavia, IL (USA)). Jul 1982. Contract AC02-76CH03000. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004262.

This technical memo documents the construction of a cold iron superconducting test magnet. The superferric magnet design was based on a concept sketch provided by Bob Wilson. Construction and dunk testing of the magnet in a liquid helium dewar took place in a time period of less than one week. The magnet operated successfully to its design field of 2 Tesla with no training.

8986 (FNAL-TM—1150) Spool piece aperture: warm to cold temperature position changes. McInturff, A.D. (Fermi National Accelerator Lab., Batavia, IL (USA)). Dec 1982. Contract AC02-76CH03000. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004274.

In an effort to determine the position of the correction coil system contained in the spool piece in operation, a series of experiments were done in Lab 2 during the cryogenic testing of the spools. A special turn-around box was constructed which had a window through which a sighting could be made of the aperture of the coil packages. A set of four survey monuments were constructed with three point suspension, which were back-lighted by placing a small bulb behind each target which could be turned on individually external to the spool string while under vacuum and at any temperature. The targets were located at the ends of each correction coil package in their beam tube.

8987 (FNAL-TM—1162) Magnetic field calculation on CDF detector (I). Yamada, R. (Fermi National Accelerator Lab., Batavia, IL (USA)). 20 Jan 1983. Contract AC02-76CH03000. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004273.

Magnetic field and flux distribution for the CDF detector is calculated using a TRIM program. The flux distribution in the system is calculated at several different excitation levels with an expected B-H curve.

8988 (FNAL-TM—1164) Lab 6 winding facility. Guerra, J.; Hansen, S.; Mangene, C. (Fermi National Accelerator Lab., Batavia, IL (USA)). 2 Feb 1983. Contract AC02-76CH03000. 8p. NTIS, PC A02. File Number DE85004265.

This note describes the winding machine installed by the facility support group at lab 6 in the Fermilab village. It is available for use by outside users and groups within the lab. The machine can wind wire planes whose longest dimension is less than 10 feet. The Wire spacing range has an upper practical limit of about 5mm. Spacing beyond this requires a very long index time and therefore slows down the winding speed prohibitively.

8989 **(FNAL-TM—1165) Pressure testing of saver single-phase bellows.** Biallas, G.; Hoffman, P. (Fermi National Accelerator Lab., Batavia, IL (USA)). 12 Aug 1981. Contract AC02-76CH03000. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004266.

Pressure pulse tests were conducted on a Saver single-phase bellows assembly. The test bellows were axially offset one-eight of an inch from the assembly center to duplicate the maximum tunnel error. The bellows service condition pulses were developed using a helium gas pressure system. No significant permanent deformation was observed in the bellows for pressure pulses with peaks up to 285 psia and plateau times up to 600 milliseconds. The bellows assembly was pressure pulsed 100 times with peak pressures equal 240 psia and plateau times equal 400 milliseconds. The bellows were determined to be leak tight down to 2.7×10^{-10} cc/sec He after the tests.

8990 **(FNAL-TM—1168) Activation of sweeping magnets in Tevatron II standardized target piles.** Cossairt, J.D. (Fermi National Accelerator Lab., Batavia, IL (USA)). Mar 1983. Contract AC02-76CH03000. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004267.

As designs of the primary targeting schemes for the new Tevatron II slow spill beams progress, it is becoming clear that a standardized form for these schemes is emerging. The general form consists of a production target (usually about 30 cm of beryllium having a diameter from 0.64 to 1.27 cm) followed by from one to three of the new Tevatron II H frame magnets recently developed by D. Eartly. These magnets sweep the unused primary proton beam onto a massive steel beam dump containing a core of material capable of dispersing the energy of the beam along with a hole for transmitting the secondary beam desired at experimental targets. Typical primary proton intensities at such production targets are planned to be in the range of 3×10^{12} to 5×10^{12} protons per spill. If one assumes such operation during a run of 4000 hours per year, 60 spills per hour, the integrated beam is seen to be approximately 1×10^{18} per year targetted at a rate of $7/0 \times 10^{10}$ protons/sec during the run. It is clear, from experience, that such beam intensities require that the water used to cool the beam dump must be in a closed loop system both to protect personnel during operations from the external radiation exposure rate due to short lived radionuclides (e.g., ^{11}C and ^{7}Be) and to protect against release of significant activities of tritium into surface waters. It is not certain that a closed loop system is required for the sweeping magnets. This TM reports on a calculation designed to evaluate this potential problem, the expected dose rates external to such magnets, and the total activity which will be contained in them and the target.

8991 **(FNAL-TM—1177) Operating manual and design report of a 5000A quench switch for Energy Doubler magnets in experimental area beamlines.** Visser, A.T. (Fermi National Accelerator Lab., Batavia, IL (USA)). Apr 1983. Contract AC02-76CH03000. 52p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85004248.

The cryogenic west bend in Proton's enclosure H consists of five 21' Energy Doubler magnets fed from a 5000A power supply via watercooled bus. The stored energy of the magnets will be dumped in a resistor R/sub D/, when S_1, S_2, are shut off. Magnet heaters will be fired if S_1, S_2, fail to open (dump failure). These heaters are strictly used for backup protection. The interlock flow diagram is shown.

8992 **(FNAL-TM—1179) Standard beam PWC for Fermilab.** Fenker, H. (Fermi National Accelerator Lab., Batavia, IL (USA)). Feb 1983. Contract AC02-76CH03000. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004249.

As one of its projects the Fermilab Experimental Areas Department has been designed and tested a relatively small proportional wire chamber for use in the secondary beam lines. It is intended to supplement the variety of detectors known in the vernacular as SWICS that are used to obtain profiles for beam tuning. The new detector, described in this report, operates in the limited proportional mode and allows experimenters to use a standard, lab supported device for associating trajectories of individual beam particles with events triggering their own experiment's apparatus. A completed triple plane module is shown.

8993 **(FNAL-TM—1180) Cryogenic system for production testing and measurement of Fermilab energy saver superconducting magnets.** Cooper, W.E.; Bianchi, A.J.; Barger, R.K.; Johnson, F.B.; McGuire, K.J.; Pinyan, K.D.; Wilson, F.R. (Fermi National Accelerator Lab., Batavia, IL (USA)). Mar 1983. Contract AC02-76CH03000. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004263.

The cryogenic system of the Fermilab Magnet Test Facility has been used to provide cooling for the testing of approximately 1200 Energy Saver superconducting magnets. The system provides liquid helium, liquid nitrogen, gas purification, and vacuum support for six magnet test stands. It provides for simultaneous high current testing of two superconducting magnets and non-high current cold testing of two additional magnets. The cryogenic system has been in operation for about 32000 hours. The 1200 magnets have taken slightly more than three years to test.

8994 **(FNAL-TM—1195) Motor control and position sensing standards: a selection guide and suggestions for new designs.** Schoo, D.P. (Fermi National Accelerator Lab., Batavia, IL (USA)). 11 Jun 1983. Contract AC02-76CH03000. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004255.

The purpose of this text is to attempt to outline and describe the standard drive and readout methods which are available as systems or modules that can be used to control motor driven dievices.

8995 **(FNAL-TM—1207) Tunnel nitrogen spill experiment.** Ageyev, A.I.; Alferov, V.N.; Mulholland, G.T. (Fermi National Accelerator Lab., Batavia, IL (USA)). 18 Aug 1983. Contract AC02-76CH03000. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004258.

The Energy Saver Safety Analysis Report (SAR) found the tunnel oxygen deficiency considerations emphasized helium spills. These reports concluded the helium quickly warms and because of its low denisty, rises to the apex of the tunnel. The oxygen content below the apex and in all but the immediate vicinity of the helium spill is essentially unchanged and guarantees an undisturbed source of oxygen especially important to fallen personnel. In contrast nitrogen spills warm slower than helium due to the ratio of the enthalpy changes per unit volume spilled spread more uniformly across the tunnel cross-section when warmed because of the much smaller density difference with air, and generally provides a greater hazard than helium spills as a result. In particular there was concern that personnel that might fall to the floor for oxygen deficiency or other reasons might find less, and not more, oxygen with dire consequences. The SAR concluded tunnel nitrogen spills were under-investigated and led to this work.

8996 **(FNAL-TM—1230) Future computing needs for Fermilab.** (Fermi National Accelerator Lab., Batavia, IL (USA)). Dec 1983. Contract AC02-76CH03000. 103p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85004252.

The following recommendations are made: (1) Significant additional computing capacity and capability beyond the present procurement should be provided by 1986. A working group with representation from the principal computer user community should be formed to begin immediately to develop the technical specifications. High priority should be assigned to providing a large user memory, software portability and a productive computing environment. (2) A networked system of VAX-equivalent super-mini computers should be established with at least one such computer dedicated to each reasonably large experiment for both online and offline analysis. The laboratory staff responsible for mini computers should be augmented in order to handle the additional work of establishing, maintaining and coordinating this system. (3) The laboratory should move decisively to a more fully interactive environment. (4) A plan for networking both inside and outside the laboratory should be developed over the next year. (5) The laboratory resources devoted to computing, including manpower, should be increased over the next two to five years. A reasonable increase would be 50% over the next two years increasing thereafter to a level of about twice the present one. (6) A standing computer coordinating group, with membership of experts from all the principal

computer user constituents of the laboratory, should be appointed by and report to the director. This group should meet on a regularly scheduled basis and be charged with continually reviewing all aspects of the laboratory computing environment.

8997 **(FNAL-TM—1249) Pumping rates for water drainage in the main ring tunnel: scale considerations of the SSC.** Treadwell, E.A. (Fermi National Accelerator Lab., Batavia, IL (USA)). Mar 1984. Contract AC02-76CH03000. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004191.

The Fermilab site has water bearing, geologic units distributed uniformly above a flat bedrock surface. These units, i.e., glacial tills, sands, and gravels are seasonably fed by fluctuations in rainfall and melting snow. Since the overall site topography is flat, ground water settles, often saturates the soil, and creates a challenge to the relatively dry requirements of the accelerator tunnel. Subsurface pumping of the water is achieved by the operation of online sump pumps, one pump in each of the 24 service buildings which access the tunnel. Drainage overflows are exhausted into a network of interconnected ponds. The objective of this note is to calculate the pumping rate for water drainage in the Main Ring Tunnel, correct for statistical and engineering fluctuations, and to discuss pumping requirements on the SSC scale.

8998 **(FNAL-TM—1251) Superconducting magnet technology for accelerators.** Palmer, R.; Tollestrup, A.V. (Fermi National Accelerator Lab., Batavia, IL (USA)). Mar 1984. Contract AC02-76CH03000. 77p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85004192.

A review article on superconducting magnets for accelerators should first answer the question, why superconductivity. The answer revolves around two pivotal facts: (1) fields in the range of 2 T to 10 T can be achieved; and (2) the operating cost can be less than conventional magnets. The relative importance of these two factors depends on the accelerator. In the case where an upgrade of an accelerator at an existing facility is planned, the ability to obtain fields higher than conventional magnets leads directly to an increase in machine energy for the given tunnel. In the case of a new facility, both factors must be balanced for the most economical machine. Ways to achieve this are discussed.

8999 **(FNAL-TM—1288) Muon fluence measurements at 800 GeV.** Elwyn, A.J.; Freeman, W.S. (Fermi National Accelerator Lab., Batavia, IL (USA)). Nov 1984. Contract AC02-76CH03000. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004113.

Muon fluence (muons-cm^{-2}) was measured downstream of enclosure PW8 at three locations along the extension of the PW beamline during the 1984 800-GeV accelerator run. The main goal of these measurements was to determine muon dose-equivalent at various Fermilab locations, and to obtain an estimate of the yearly off-site radiation exposure to the general population due to accelerator-produced muons. The contribution from the PW beamline was investigated because the targeted primary proton beam intensity was consistently higher than for other beamlines. More extensive but similar measurements have been reported by Cossairt for 350 and 400 GeV operation.

9000 **(FNAL-TM—1289) Observations on LEP with a view to SSC.** Toohig, T.E. (Fermi National Accelerator Lab., Batavia, IL (USA)). 23 Nov 1984. Contract AC02-76CH03000. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004121.

From 24-29 October 1984 a visit was made to the LEP project at CERN with a view to extracting from the LEP planning and experience what might be useful in planning an SSC. With a circumference of 26.7 km, in a reasonably densely-populated area outside the boundaries of the CERN site, LEP already faces most of the problems of environment, public relations, maintenance and operation that will be faced by an SSC project. Information is presented under the headings of: (1) radiation protection; (2) heating, ventilation, and airconditioning; (3) electrical power distribution; (4) LEP experiments/UA1, UA2; (5) civil; (6) infrastructure installation; (7) survey; (8) safety; and (9) LEP controls. Each report lists the CERN individuals who generously provided their insights and help.

9001 **(FNAL-TM—1291) Fermilab accumulator magnets vacuum chamber heating system.** Satti, J.A.; Lee, G.N. (Fermi National Accelerator Lab., Batavia, IL (USA)). Dec 1984. Contract AC02-76CH03000. 16p. (CONF-841218—13). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004114.

From 31. national vacuum symposium; Reno, NV, USA (3 Dec 1984).

The Fermi National Accelerator Laboratory (Fermilab) is building an Accumulator Ring to store antiprotons for high energy physics proton-antiproton collisions in the Tevatron accelerator. The Accumulator Ring approximately 474 m in circumference, consists of many quadrupole and dipole magnets connected with stainless steel vacuum chambers for beam circulation. The vacuum pressure required is in the low 10^{-10} Torr range. To reach this pressure, the vacuum chambers are bake to 300°C each time they have been opened to atmospheric pressure. The critical problem is to bake the chambers in the magnets at high temperature without overheating the laminated magnets. Some of the magnets are 5 m long with very restrictive space for the heaters and insulation. An average space of only 7.5 mm around the chambers is available. In this space a heating system has been designed and tested to heat the chamber to 300°C and allow a maximum temperature of 65°C nest to the magnet components. This was accomplished by using a heating blanket completely covered with a water cooled copper heat sink jacket to protect the magnet from the high temperatures. The design of a final selected heating blanket is discussed. A prototype test results are given with comparison of calculated and measured temperature distribution.

9002 **(LA-UR—84-3506) Nuclear physics in the 10 to 300 MeV energy range using a pulsed white neutron source.** Bowman, C.D.; Wender, S.A.; Auchampaugh, G.F. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 17p. (CONF-840945—11). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003713.

From Topical conference on neutron-nucleus collisions--a probe of nuclear structure; Glouster, OH, USA (5 Sep 1984).

A new pulsed white neutron source is under construction at the Los Alamos WNR facility. The neutrons are produced by LAMPF proton micropulses striking thick targets of various materials. Beam parameters include energy of 800 MeV, pulse rate of approximately 50,000 Hz, 0.4 nsec pulse width, average current as high as 6μa, and a useful neutron energy range from 3 to 300 MeV. The facility will receive beam approximately 80% of the time LAMPF is operational; it increased by a factor of 1000 the experimental capability over the present system at the WNR when beam intensity, angular distribution, and availability are taken into account. In addition to established white source techniques, the facility is also highly competitive with monoenergetic sources for a wide class of experiments such as neutron capture γ ray spectroscopy and neutron-induced charged particle reactions. The facility should be operational in about nine months. Arrangements are underway to make the facility readily accessible to visiting experimenters.

9003 **(LBL—18500) Accelerator and Fusion Research Division: summary of activities, 1983.** (Lawrence Berkeley Lab., CA (USA)). Aug 1984. Contract AC03-76SF00098. 75p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85003166.

The activities described in this summary of the Accelerator and Fusion Research Division are diverse, yet united by a common theme: it is our purpose to explore technologically advanced techniques for the production, acceleration, or transport of high-energy beams. These beams may be the heavy ions of interest in nuclear science, medical research, and heavy-ion inertial-confinement fusion; they may be beams of deuterium and hydrogen atoms, used to heat and confine plasmas in magnetic fusion experiments; they may be ultrahigh-energy protons for the next high-energy hadron collider; or they may be high-brilliance, highly coherent, picosecond pulses of synchrotron radiation.

9004 (LBL—18500, pp 2-3) **Operations summary.** Aug 1984. NTIS, PC A04/MF A01. File Number DE85003166.

In Accelerator and Fusion Research Division: summary of activities, 1983.

During fiscal 1983, the Bevalac and SuperHILAC provided 5302 hours of beam time for nuclear science and biomedical experiments. One hundred seventy-five scientists participated in the research programs. As national facilities, the Bevalac and SuperHILAC are used by qualified researchers from around the world; about half of the available research time is used by scientists not affiliated with LBL. Beam time is apportioned by Program Advisory Committees, which review submitted proposals twice each year. In addition, the users have formed users' associations for the purpose of exchanging information and recommending operational and procedural improvements.

9005 (LBL—18500, pp 4-8) **Research by accelerator users: highlights.** Aug 1984. NTIS, PC A04/MF A01. File Number DE85003166.

In Accelerator and Fusion Research Division: summary of activities, 1983.

Nuclear physics at the Bevalac centers around the use of relativistic heavy-ion beams unavailable at any other facility in the world: fully stripped uranium nuclei, for example, can now be produced at energies of 960 MeV/amu. Several experiments in 1983 focused on processes within nuclei compressed to nearly four times normal density and heated to more than 100 MeV (roughly 10^{12} degrees Celsius). The resulting observations nourish the hope of reaching higher energy densities in expectation of seeing a plasma of elemental quarks and gluons. Other experiments have illuminated the process of particle production within the nuclear volume, the mechanism of ion energy loss in matter, and the hydrodynamical behavior of nuclei during nuclear collisions. Still other results have suggested the existence of nuclear fragments (so-called anomalons) that interact in nuclear emulsions much more strongly than current theory would allow. Researchers at the SuperHILAC have continued to study heavy-ion reaction mechanisms and atomic physics. The use of SuperHILAC beams to ionize a gas, thus producing highly charged heavy ions with low kinetic energy, has, in fact, been a major contributor to the recent renaissance of atomic spectroscopy. At the same time, the biology and medicine program has used the unique features of heavy-ion beams in very different ways, conducting clinical studies of their value for local tumor control and for radiosurgery.

9006 (LBL—18500, pp 56-60) **Research on future light sources.** Aug 1984. NTIS, PC A04/MF A01. File Number DE85003166.

In Accelerator and Fusion Research Division: summary of activities, 1983.

Synchrotron radiation is being increasingly viewed as an optical probe with enormous potential in many fields of research. Exploiting this potential will mean constructing an advanced facility as a source of intense coherent light. Such a source will require an electron beam of low emittance, together with insertion devices (wigglers and undulators) that cause small-amplitude oscillations in the beam. The result is tunable coherent xuv radiation of great spectral brilliance - radiation that will be an invaluable research tool in the biological sciences, in atomic and molecular physics, in studies of chemical reactivity, and in the materials and surface sciences. The ALS, proposed in 1982, would be a source of such light over a wide energy spectrum. Additional work has already produced advanced beam-line components, preliminary evaluations of vacuum component material and fabrication techniques, and undulator designs that yield light of variable polarization.

9007 (LBL—18500, pp 61-65) **Free-electron laser.** Aug 1984. NTIS, PC A04/MF A01. File Number DE85003166.

In Accelerator and Fusion Research Division: summary of activities, 1983.

A free-electron laser converts the kinetic energy of a relativistic beam of electrons into coherent radiation, usually by means of a periodic array of magnets called a wiggler. Together with workers at Lawrence Livermore National Laboratory, we have constructed an electron laser facility and use it to amplify 34.6-GHz microwave radiation. Ultimately, this technique might be used as an alternative to the gyratron as the basis for electron-cyclotron resonance heating - the likely source of the hot electrons required in some approaches to magnetic-confinement fusion. The free-electron laser also allows us to study the feasibility of a linear collider of, say, 300 GeV x 300 GeV. The practical possibility of such a collider depends on establishing a high accelerating gradient and effecting economies of power consumption. We can do both by operating at high frequencies, and the FEL offers just this possibility.

9008 (LBL—18500, pp 65-67) **Medical accelerator.** Aug 1984. NTIS, PC A04/MF A01. File Number DE85003166.

In Accelerator and Fusion Research Division: summary of activities, 1983.

The failure of conventional radiotherapy to control cancers at their sites of origin, before they spread more widely, accounts for about 100,000 deaths in the US each year. A possibility for reducing this number is the therapeutic use of heavy ions in place of x-rays. Heavy charged particles are more effective than x-rays in killing oxygen-starved tumor cells, and, unlike neutrons, they allow the dose to be localized with great precision. Studies of charged-particle radiotherapy are currently conducted by LBL's Biology and Medicine Division at the Bevalac and the 184-Inch Cyclotron, but more conclusive trials, together with a more extensive program of basic biophysics research, require a hospital-based facility. As now conceived, such a facility would be based on a synchrotron about 30 meters in diameter, which would accelerate ion species from protons to argon to energies up to 800 MeV/amu. Beams could be delivered sequentially to different treatment rooms, thus permitting treatment of about 100 patients per day.

9009 (SLAC-PUB—3467) **Design and performance of the Stanford Linear Collider Control System.** Melen, R.E. (Stanford Linear Accelerator Center, CA (USA)). Oct 1984. Contract AC03-76SF00515. 8p. (CONF-841007—34). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004383.

From Nuclear science symposium; Orlando, FL, USA (31 Oct 1984).

The success of the Stanford Linear Collider (SLC) will be dependent upon the implementation of a very large advanced computer-based instrumentation and control system. This paper describes the architectural design of this system as well as a critique of its performance. This critique is based on experience obtained from its use in the control and monitoring of 1/3 of the SLAC linac and in support of an expensive experimental machine physics experimental program. 11 references, 3 figures.

9010 (TRI-PP—84-94) **Remote machining and robotic welding in a proton cyclotron.** Cameron, W.; Mark, C. (British Columbia Univ., Vancouver (Canada). TRIUMF Facility). Sep 1984. 6p. (CONF-840916—5). NTIS (US Sales Only), PC A02/MF A01. File Number DE85900434.

From Robotics and remote handling in the nuclear industry conference; Toronto, Ontario, Canada (23 Sep 1984).

Increasing residual radiation in the TRIUMF meson research facility cyclotron at the University of British Columbia has required development of a remotely operable industrial robot cutting and vacuum tight welding capability for modification and updating of vacuum tank access ports, and for possible repairs of leaks or holes in the vacuum tank periphery.

9011 (TRI-PP—84-95) **Workshop report on polarized proton ion sources.** Schmor, P.W. (British Columbia Univ., Vancouver (Canada). TRIUMF Facility). Sep 1984. 7p. (CONF-8409162—6). NTIS (US Sales Only), PC A02/MF A01. File Number DE85900436.

From 6. international symposium on high energy spin physics; Marseille, France (12 Sep 1984).

The results from a workshop, during May 1983, which examined the capabilities and future possibilities of polarized proton sources are summarized. The best Lamp-shift sources have achieved 4 μA but the potential for further increase is limited by the proton source brightness. Atomic sources have reached the ~ μA H^- vector range and techniques for increasing this to ~ 1 mA are proposed. Techniques for achieving intense pulsed beams with ultra cold atomic sources are described. Results from an optically pumped H^- vector ion source at KEK are given along with alternative schemes for producing polarized atomic hydrogen by optical pumping.

4304 Storage Rings

REFER ALSO TO CITATION(S) 4304009015

44 INSTRUMENTATION

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 4401008936, 8983, 9176, 9242, 9394

9012 **(AD—465332/5/XAD) Evaluation of standard Navy dosimeters DT-60/PD and IM-107/PD in residual radiation fields aboard ships.** Rainey, S.C.; Duckworth, J.W.; Freedman, L.A. (Bureau of Ships, Washington, DC (USA)). 27 Mar 1959. 46p. NTIS, PC A03/MF A01.

Report on Operation Redwing -- Project 2.72.

Standard Navy dosimeters DT-60/PD (phosphor glass) and IM-107/PD (quartz fiber) were mounted on the surface of masonite man-sized phantoms and exposed to radiation fields caused by deposited fallout on the YAG-39 and YAG-40 in order to evaluate their response in terms of the 3-to-5-cm-depth dose. This dose is considered a more satisfactory indicator for the evaluation of acute effects to personnel in nuclear warfare than is the air dose. Depth-dose configurations in these phantoms were determined by means of phosphate-glass needles. The radiation doses indicated by the surface detectors were compared with those at a depth of 3 cm. Differences and scatter in the readings of the two types of standard dosimeters, and differences between the surface readings and the depth readings, indicate that the DT-60/PD and IM-107/PD dosimeters are not satisfactory in their present form for proper measurement and interpretation of the radiation dose received by shipboard personnel above decks in a fallout field.

9013 **(CAPE—2942) Biomed Alpha Counter - scintillation counter sample chamber (Engineering Materials).** (Oak Ridge National Lab., TN (USA)). 18 Jan 1962. Contract AC05-84OR21400. OSTI. File Number TI85004180.

Alpha scintillation detector (Q2287-1) was designed for counting alpha activity in dry samples or smears taken by Health Physicist. This design was modified and assembled according to drawing Q2979-1 for counting very low activity samples for long time periods. The modified version had lower background contribution which was necessary for counting lower activity samples.

9014 **(CERN—84-03) BST-PINK PANTHER. An intelligent CAMAC crate controller.** Troester, D.A. (European Organization for Nuclear Research, Geneva (Switzerland)). 21 Mar 1984. 39p. NTIS (US Sales Only), PC A03/MF A01. File Number TI84703476.

A technical and functional description of the PINK system for intelligent, distributed data acquisition, data formatting, and data reduction is presented. The system has been developed to bypass some of the constraints of CAMAC when collecting data with the high-resolution π^0 spectrometers of the Basel-Stockholm-Thessaloniki (BST) Collaboration at CERN.

9015 **(DESY—84-063) Compact and inexpensive radiation monitoring device.** Moser, H.; Grassman, H.; Wegener, H.; Fonseca, V.; Lorenz, E.; Scheer, A. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Jul 1984. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number TI85750478.

A simple radiation monitoring device consisting of a small CsI(T1) crystal coupled to a large area silicon photodiode is described. For maximum stability the photodiode is operated as a photoelement and connected to a current amplifier with picoampere sensitivity. The device is very compact and insensitive to magnetic fields. With careful construction the device can be made sensitive down to 0.2 μRad/s.

9016 (DOE/ER/04699—T1, pp vp, Appendix D) **Report on the performance of the Pb-glass detectors.** Gilot, J.F. 1983. NTIS, PC A08/MF A01. File Number DE84005145.

In Experiments on the TASS and HISS spectrometers at the Bevalac. Annual progress report, April 1, 1983-March 31, 1984.

At the beginning of this year 24 lead glass scintillators were received to be tested for the lepton experiment. They will be used for electron-pion separation and γ ray detection in a range of momentum between 50 and 500 MeV/c. One of the lead glass blocks was tested very carefully with the minimum ionizing particles from the cosmic rays (high energy muons). In addition 15 other blocks were tested.

9017 (DOE/ER/04699—T1, pp vp, Appendix E) **Results of the initial instrument test for E-670H.** Gilot, J.F. 1983. NTIS, PC A08/MF A01. File Number DE84005145.

In Experiments on the TASS and HISS spectrometers at the Bevalac. Annual progress report, April 1, 1983-March 31, 1984.

During the month of May 1983, we carried out some tests with electrons at the Bevelac. The experimental set-up is shown. The goals of these tests were to study the response of the gas Cherenkov counters to electrons and to measure the e-π separation in the lead glass counters.

9018 (DOE/ER/04699—T1, pp vp, Appendix F) **Magnitude and the uncertainty in the solid angles of TASS in the configuration of E-444H.** Kirk, P.N. 1983. NTIS, PC A08/MF A01. File Number DE84005145.

In Experiments on the TASS and HISS spectrometers at the Bevalac. Annual progress report, April 1, 1983-March 31, 1984.

In this report values of the solid angle for both arms of TASS are presented and compared with Treuhaft's values. In addition the uncertainties in the magnitudes of the solid angles are discussed, and the factors that dominate these uncertainties are identified. Unfortunately, the uncertainties in the solid angles are strong functions of momentum and in order that we may use more of the solid angle in future experiments we must be able to calculate these uncertainties reliably. This report is intended to demonstrate one approach to this problem. Because of the necessity for a comparison with Treuhaft's values, the results presented here are valid only for the specific configuration of detectors in E444H. Some of the conclusions, however, are believed to be of general validity, and for this reason they may be useful in planning future experiments.

9019 **(FNAL-TM—1157) E-537 MWPC amplifier.** Kephart, R.; Kerns, C. (Fermi National Accelerator Lab., Batavia, IL (USA)). 17 Sep 1979. Contract AC02-76CH03000. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004270.

The design of a fast MWPC amplifier for the beam chambers and the absorber chamber is completed and all parts are on order. A prototype 16 channel board has been built and satisfactorily tested. Artwork is completed for the board and out to be photographed. The board fabrication contract has been let. Listed below is a summary of the amplifier characteristics as well as test results obtained with the prototype.

9020 **(FNAL-TM—1158) High sensitivity amplifier/discriminator for PWC's.** Hansen, S. (Fermi National Accelerator Lab., Batavia, IL (USA)). Jan 1983. Contract AC02-76CH03000. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004271.

The facility support group at Fermilab is designing and building a general purpose beam chamber for use in several locations at the laboratory. This pwc has 128 wires per plane spaced 1 mm apart. An initial production of 25 signal planes is anticipated. In proportional chambers, the size of the signal depends exponentially on the charge stored per unit of length along the anode wire. As the wire spacing decreases, the capacitance per unit length decreases, thereby requiring increased applied voltage to restore the necessary charge per unit length. In practical terms, this phenomenon is responsible for difficulties in constructing chambers with less than 2 mm wire spacing. 1 mm chambers, therefore, are frequently operated very near to their breakdown point and/or a high gain gas containing organic compounds such as magic gas is used. This argon/iso-butane mixture has three drawbacks: it is explosive when exposed to the air, it leaves a residue on the wires after extended use and is costly. An amplifier with higher sensitivity would reduce the problems associated with operating chambers with small wire

spacings and allow them to be run a safe margin below their breakdown voltage even with an inorganic gas mixture such as argon/CO2, this eliminating the need to use magic gas. Described here is a low cost amplifier with a usable threshold of less than 0.5 μA. Data on the performance of this amplifier/discriminator in operation on a prototype beam chamber are given. This data shows the advantages of the high sensitivity of this design.

9021 **(FNAL-TM—1201) Beamline transition radiation detector for MW.** Haggerty, H. (Fermi National Accelerator Lab., Batavia, IL (USA)). 6 Jun 1983. Contract AC02-76CH03000. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004257.

Recent developments of transition radiation detectors (TRD's) indicate that an efficient and practical system can be deployed for beam line particle tagging for momenta greater than 200 GeV/c. This note describes the design of a prototype system to be tested at Fermilab in Fall, 1983. Pre-prototype testing was done at BNL in March, 1983 and has been followed up by bench testing of gasses and electronics at Fermilab. The design goal is a modular system which puts few contraints on beam line configuration and hence can be adapted to any high energy secondary beam.

9022 **(FNAL-TM—1284) New preamplifier for particle detectors.** Yarema, R.J. (Fermi National Accelerator Lab., Batavia, IL (USA)). Nov 1984. Contract AC02-76CH03000. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004115.

A new preamplifier for particle detectors has been designed and built for the Fermilab VTPC by Fujitsu of Japan. The device, designated MB43458, is a semi-custom monolithic assembled in a small, low mass package. The purpose of this report is to document the preliminary tests which have been done thus far. Tests are continuing to expand upon the results presented herein.

9023 **(JINR—10-83-598) Software for the two-parameter experiments on the base of the SM-3 computer and CAMAC apparatus.** Gridnev, G.F.; Salamatina, T.S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1983. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number TI84703478.

Software for two-dimensional experiments on the base of the SM-3 computer and CAMAC apparatus is developed. A color TV monitor is used as a graphic display device. The system operates under the DOS FOBOS control. The user can accumulate the data in the form on integral spectra with dimensions of 64x64 or 64x128 channels observe the procedure of spectrum unfolding in a plane (256x256 channels), observe two-dimensional spectrum in axonometry and in the form of a plane with brightness of points proportional to the logarithm of countings in a channel; record and store the data on a magnetic disk print the spectra in the form two-dimensional matrices, tables, or diagrams diagnose failures and errors; and use the regime of operator-computer dialogue. The software has been used in the experiments with the U-400 accelerator since 1982.

9024 **(LA-UR—84-3634) X-ray gauge measures areal density variations as small as 0.1%.** Stupin, D.M. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 16p. (CONF-841218—12). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003774.

From 31. national vacuum symposium; Reno, NV, USA (3 Dec 1984).

A gauge measures areal density variations as small as 0.1% in low density plastic foams and other materials. It has a spatial resolution of 0.5 mm. This system is safe, portable, easy to use, and is readily automated. The 6 keV x-ray flux from a ^{55}Fe source is collimated to a 0.5 mm diameter beam and attenuated by the sample. Transmitted x-rays are detected with a proportional gas detector and counted with a scaler-timer. After measuring the x-ray attenuation in two areas of the sample, the areal density variation is calculated using an expression derived from $I/I_0 = \exp(-upx)$ where I is the transmitted flux, I_0 is the incident flux, u is the mass attenuation coefficient of the sample, p is the foam density, x is the thickness of the sample, and the product $px = D$ is the areal density. Measurements sensitive to 1% and 0.1% areal density variations take three minutes and four hours per point, respectively, in 0.05 g/cm^3 plastics, 1 cm thick. Absolute areal density is also measured to +-3% using existing x-ray attenuation tables. However, better accuracy may be obtained by calibrating the system with known samples.

9025 **(MPI-PAE/Exp.El.—133) Beam tube chamber of the CELLO Detector.** Sack, B. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.). Werner-Heisenberg-Inst. fuer Physik; Hamburg Univ. (Germany, F.R.). Fachbereich Physik). Jun 1984. 88p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number TI85750482.

The beam tube chamber of the CELLO detector is since September 1982 in operation and works without problem. The main aim of this thesis was to determine by using muons from the cosmic radiation the improvement in the momentum and vertex resolution by the beam tube chamber. Before this comparison could be performed the accurate position of the beam tube chamber had to be determined. After the performed position determination the spatial resolution amounts to 181 μm. The expected improvement factors could be reached completely both by cosmic radiation and by Bhabha events not studied in this thesis. The transverse momentum resolution amounts to the 1.18% x psub(T)(GeV/c). The vertex resolution is improved to 300 μm. Additionally by the beam tube chamber the time of events can be measured with an occuracy of 5.7 ns. Finally it remains to be remarked that the beam tube chamber satisfies completely the requirements and represents a simple, but efficient supplement to the CELLO detector..

9026 **(RFP—3634) Moisture resistant, semi-automatically assembled, low cost air proportional alpha detector.** Aldrich, J.M.; Tyree, W.H.; Urano, H.; McClure, J.P.; Overly, E.C.; Cunningham, K.R. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1984. Contract AC04-76DP03533. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003903.

An air proportional alpha survey detector developed by Rockwell International at the Rocky Flats Plant appears to function properly in 95 plus % relative humidity environments. This was substantiated by continuous detector operation (24 hours/day for $>$ 9 days) inside an environmental test chamber. The important test parameters included a relative humidity range of 80 to 98%, a temperature range of 60 to 86°F, and a test voltage of 2000 volts. When compared to the present probe under these test conditions, the detector also exhibited a much improved signal to noise ratio. This air proportional detector consists of an aluminum die cast body, two Ryton 10 injection molded insulators, a spring tensioned tungsten anode wire system, and an entrance window of $\leqq$ 25 gauge double aluminumized mylar held in place with double faced adhesive tape. This unique combination has provided: a completely sealed detection chamber; semi-automatic assembly, low cost, ~ $30 per complete assembly, durability, simplicity, a more uniform response, an increase in sensitivity of 20 to 30%, and the ability to retain the concept of an external removable screen for prompt decontamination during use in the field. Rockwell is in the process of purchasing and implementing 3000 plus of these detectors for field use during FY 1984.

4402 Radiation Effects On Instrument Components,

Instruments, Or Electronic Systems

REFER ALSO TO CITATION(S) 4402008584

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 4403008125, 8476, 8792, 8923

9027 **(DOE/ER/45017—1) Inelastic scattering in condensed matter with high intensity Moessbauer radiation. Progress report, August 1, 1983-February 28, 1985.** Yelon, W.B.; Schupp, G.; Mullen, J.G. (Missouri Univ., Columbia (USA); Purdue Univ., Lafayette, IN (USA)). Oct 1984. Contract AC02-83ER45017. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003531.

The design and construction phases for the Microfoil Internal Conversion Electron (MICE) detector have been completed and it has been interfaced into the computer control for our high intensity Moessbauer scattering instrument. Thorough evaluation and optimization of MICE for low temperature operation are in progress. Data already taken, however, show that it gives an order of magnitude enhancement in signal-to-background compared to the Ge detector used in a transmission geometry. Publications about the performance of MICE, about thermal diffuse scattering studies on Si, and about charge density wave studies on TaS_2 are forthcoming.

9028 **(MLM—3214(OP)) Fast times at high temperatures.** Kelly, M.D.; Abney, L.D. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1984. Contract AC04-76DP00053. 9p. (CONF-8411120—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003306.

From 7. International Society for Optical Engineering meeting on thermosense; Cambridge, MA, USA (5 Nov 1984).

High temperatures generated during rapid thermal reactions require techniques to index time and calibrate high temperature. The technique used to establish time required the design and fabrication of a time indexing constant temperature source to measure reaction times. A unique black body source was used for high temperature calibration. These techniques and their applications will be discussed.

9029 **(RFP—3607) Low temperature calibration fixture.** Thompson, R.L.; Stant, R.S.; Sackuvich, R. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 4 Nov 1984. Contract AC04-76DP03533. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003969.

A very inexpensive, easy-to-use calibration fixture has been developed and tested. The fixture allows calibrations from -195 to -20°C with a worst case transfer uncertainty of less than +-0.1°C. Construction and testing details are provided.

9030 **(RFP—3618) Automated thermocouple calibration system.** Thompson, R.L.; Stant, R.S. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). Oct 1983. Contract AC04-76DP03533. 62p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85003933.

The Rocky Flats Physical Metrology Laboratory currently calibrates over 1500 thermocouples per year. To handle this workload efficiently, five automated thermocouple calibration systems were built and are currently in daily use. These computer controlled calibration systems routinely perform calibrations from -200 to +1600°C. They are designed to collect data in a ballistic or cooldown mode, although an option to collect data at a fixed point exists. These systems also are used to survey plant production furnaces and to make multiple resistance measurements. Since starting to use these systems the measurement repeatability has improved 10-fold, while the man-hours required per calibration has been drastically reduced. Construction details are provided.

9031 **Optical double-slit particle measuring system.** Hencken, K.R.; Tichenor, D.A.; Wang, J.C.F. (to Dept. of Energy). US Patent 4,441,816. 10 Apr 1984. Filed date 25 Mar 1982. vp.

PAT-APPL-361954.

A method for in situ measurement of particle size is described. The size information is obtained by scanning an image of the particle across a double-slit mask and observing the transmitted light. This method is useful when the particle size of primary interest is 3 μm and larger. The technique is well suited to applications in which the particles are non-spherical and have unknown refractive index. It is particularly well suited to high temperature environments in which the particle incandescence provides the light source.

45 EXPLOSIONS AND EXPLOSIVES

REFER ALSO TO CITATION(S) 4500008283, 8952

9032 **(SC-DR—70-654) User's manual for CHART D.** Thompson, S.L. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1970. Contract AC04-76DP00789. 41p. NTIS, PC A03. File Number DE85003782.

Many changes have been made over the past year in the physical content of the CHART D radiation-diffusion hydrodynamic code, particularly in high-explosive, elastic-plastic, and distended material routines; analytic equations of state; and radiation calculations. This report, intended as a user's manual, gives the input-output changes.

4501 Chemical

REFER ALSO TO CITATION(S) 4501008242

9033 **(UCRL—88975) Velocity of spherically-diverging detonation waves in RX-26-AF, LX-17 and LX-10.** Bahl, K.L.; Lee, R.S.; Weingart, R.C. (Lawrence Livermore National Lab., CA (USA)). 15 Jul 1983. Contract W-7405-ENG-48. 5p. (CONF-830719—61). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004371.

From American Physical Society meeting on shock waves in condensed media; Santa Fe, NM, USA (18 Jul 1983).

The velocity of spherically-diverging detonation waves was measured in RX-26-AF, LX-17 and LX-10 explosives at 20°C and -54°C for detonation wave radii from 13 to 50 mm. At the smaller radii the measured velocities were lower than published steady detonation velocities by as much as 4%. The detonation velocities measured at -54°C were usually higher than those measured at room temperature. These results indicate that a significant part of the excess transit time observed when an explosive is initiated by a point or hemispherical detonator may be due to a low detonation velocity.

9034 **Integral low-energy thermite igniter.** Gibson, A.; Kaws, L.D.; Mohler, J.H. (to Dept. of Energy). US Patent 4,464,989. 14 Aug 1984. Filed date 13 May 1983. vp.

PAT-APPL-494487.

In a thermite igniter/heat source comprising a container holding an internal igniter load, there is provided the improvement wherein the container consists essentially of consumable consolidated thermite having a low gas output upon combustion, whereby upon ignition, substantially all of the container and said load is consumed with low gas production.

9035 **Method for synthesizing HMX.** McGuire, R.R.; Coon, C.L.; Harrar, J.E.; Pearson, R.K. (to Dept. of Energy). US Patent 4,432,902. 21 Feb 1984. Filed date 20 Jul 1982. vp.

PAT-APPL-399948.

A method and apparatus for electrochemically synthesizing N_2O_5 includes oxidizing a solution of N_2O_4/HNO_3 at an anode, while maintaining a controlled potential between the N_2O_4/HNO_3 solution and the anode. A potential of about 1.35 to 2.0 V vs. SCE is preferred, while a potential of about 1.80 V vs. SCE is most preferred. Thereafter, the N_2O_5 is reacted with either 1.5-diacetyl-3,7-dinitro-1,3,5,7-tetraazacyclooctane (DADN) or 1,3,5,7-tetraacetyl-1,3,5,7-tetraazacyclooctane (TAT) to form cyclotetramethylenetetraamine (HMX).

4502 Nuclear

REFER ALSO TO CITATION(S) 4502009057

9036 **(AD-A—144408/2) Evaluation of methodologies for estimating vulnerability to electromagnetic pulse effects.** (National Research Council, Washington, DC (USA). Committee on Electromagnetic Pulse Environment). 1984. 111p. NTIS, PC A06/MF A01.

High-altitude electromagnetic pulse (EMP) is an electromagnetic radiation of very short rise time, large amplitude, and brief duration that follows a nuclear explosion above the atmosphere. The area over which a single EMP event is experienced can be very great if the explosion if high enough and large enough. Several such nuclear explosions might render unprotected electronic equipment and systems inoperative over an area as large as the continental United States. Damage may occur when high currents and voltages, driven by EMP, reach vital internal circuits. It is therefore essential to protect the systems and to form some idea of how well they will withstand EMP.

9037 **(CONF-8311200—) Second US-Japan joint workshop for reassessment of atomic bomb radiation dosimetry in Hiroshima and Nagasaki: proceedings.** (Radiation Effects Research Foundation, Hiroshima (Japan)). Feb 1984. 127p. Radiation Effects Research Foundation, 5-2 Hijiyama Park, Minami-Ku, Hiroshima 730, Japan. File Number TI85003102.

From US/Japan joint workshop on a-bomb dosimetry reassessment; Hiroshima, Japan (8 Nov 1983).

The goals of the workshop were to exchange information on physical characteristics leading to estimates of the dose to surviving individuals and to clarify pathways leading to this goal. Structural shielding and organ doses were emphasized. Individual papers have been entered into the data base separately. (ACR)

9038 **(UCRL—90920) Analysis of large urban fires.** Kang, S.W.; Reitter, T.A.; Takata, A.N. (Lawrence Livermore National Lab., CA (USA)). Nov 1984. Contract W-7405-ENG-48. 12p. (CONF-850136—1). NTIS, PC A02. File Number DE85003453.

From 23. AIAA aerospace sciences meeting; Reno, NV, USA (14 Jan 1985).

Fires in urban areas caused by a nuclear burst are analyzed as a first step towards determining their smoke-generation chacteristics, which may have grave implications for global-scale climatic consequences. A chain of events and their component processes which would follow a nuclear attack are described. A numerical code is currently being developed to calculate ultimately the smoke production rate for a given attack scenario. Available models for most of the processes are incorporated into the code. Sample calculations of urban fire-development history performed in the code for an idealized uniform city are presented. Preliminary results indicate the importance of the wind, thermal radiation transmission, fuel distributions, and ignition thresholds on the urban fire spread characteristics. Future plans are to improve the existing models and develop new ones to characterize smoke production from large urban fires. 21 references, 18 figures.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

5001 Basic Studies

9039 **(AD-A—146057/5/XAD) Particle size distribution on surfaces in clean rooms. Final technical report September 1983-February 1984.** Hamberg, O.; Shon, E.M. (Aerospace Corp., El Segundo, CA (USA). Vehicle Engineering Div.). 30 Apr 1984. 27p. (TR—0084(4902-06)-1). NTIS, PC A03/MF A01.

Experimental particle size distributions of surfaces in clean rooms, resulting from the gravity settling of airborne particulates (fallout), are presented and found to be significantly different from the distributions described by Military Standard 1246A. Theoretical surface size distributions, based on fallout from a Federal Standard 209B airborne particle distribution, are derived and show good correlation with experimental data. Further experimental data and analysis are provided to show that surface cleaning tends to make a particle size distribution resulting from fallout approach the MIL-STD-1246A distribution. Recommendations are made to limit the use of MIL-STD-1246A, when specifying surface cleanliness levels, to surfaces that have been cleaned after exposure to fallout.

9040 **(PB—85-106698/XAD) Diurnal and seasonal patterns of temperature and wind flow in the planetary boundary layer for ten locations in complex terrain.** Truppi, L.E. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab.). Oct 1984. 15p. (EPA—600/D-84/248). NTIS, PC A02/MF A01.

In support of the Complex Terrain Model Development program, climatological summaries in the form of vertical profiles of wind and temperature were produced from a special computer file of radiosonde data created from twice daily observations recorded at ten National Weather Service stations located in the Rocky Mountain and Great Basin regions of the United States. Seasonal and diurnal patterns were presented showing terrain influence at each radiosonde location characteristic of early morning and late afternoon conditions. Although climatalogical patterns were related to the particular valley-ridge topography of the radiosonde site, terrain influence can be estimated at nearby site where data are required for studies of the planetary boundary layer, as in atmospheric dispersion modeling.

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 5002008185, 8186, 8191, 8211, 8212, 8294, 8422, 8448, 8764, 8776, 8777, 8779, 8879, 8880, 9038, 9114

9041 **(AD-A—146188/8/XAD) Investigation of a cryogenic matrix isolation approach for characterizing phosphorus acid aerosol. Final report September 1981-June 1983.** Snelson, A. (IIT Research Inst., Chicago, IL (USA)). Jul 1984. 60p. NTIS, PC A04/MF A01.

A matrix isolation cryostat has been adapted to sample gas streams containing aerosols for the latters subsequent analysis by infrared spectroscopy. The aerosol sampling was made in basically one of two modes: (1) the aerosol and its carrier gas were both condensed at 10K on the IR-transmitting surface, or (2) the aerosol alone was condensed on the IR-transmitting surface maintained at a temperature insufficient to condense the carrier gas. IR spectra of the condensed air + aerosol, or the aerosol alone, were then obtained. By suitably varying the temperature of the IR-transmitting surface, the air was distilled off leaving the aerosol behind. For aqueous aerosols containing non volatile solutes, the water could be partially or completely removed by raising the temperature of the condensed material to approximately 200K, followed by recooling to 10K for spectral analyses.

9042 **(AD-A—146349/6/XAD) Statistical research support on Navy fire protection and fuel technology programs. Final technical report.** Smith, D.E. (Desmatics, Inc., State College, PA (USA)). Sep 1984. 20p. (TR—116-1). NTIS, PC A02/MF A01.

NRL collected data on the concentration levels attained by carbon monoxide, carbon dioxide and oxygen during a number of free-burning fires of different sizes (2, 7, 15, 50 and 100 cm diameter). The duration of most fires was approximately thirty minutes. Each fire consisted of three phases: start-up, burning, and suppression. The burning periods, determined via the examination of the gas concentration level-time plots, were based on an interval around the midpoint of the sequence of observations. To aid NRL in its research, Desmatics conducted a statistical analysis of gas concentration build-up and depletion rates during the burning period.

9043 (AD-A—146467/6/XAD) Design and operation of a real-time polynuclear aromatic hydrocarbon (PAH) monitor for the analysis of combustion products formed in the incineration of navy colored smoke compositions. Final report December 1982-October 1983. Loda, R.T. (Naval Weapons Center, China Lake, CA (USA)). Aug 1984. 139p. (NWC-TP—6525). NTIS, PC A07/MF A01.

This publication describes the design and construction of a fluorescence-based polynuclear aromatic hydrocarbon (PAH) monitor and calibration system. It also covers the installation and operation of this real-time monitor system during the incineration testing of Navy colored smoke compositions at the Los Alamos National Laboratory Controlled Air Incinerator facility, Los Alamos, N. Mex. During these tests, no PAHs were found to be present in the incinerator effluent gases at a concentration level > approx 1 ppm (the approximate gas-phase detection limit of the monitor). Recommendations are listed for future system improvements.

9044 (CONF-840177—1) Forest damage and automobile exhaust gases. Gwinner, D. (Daimler-Benz A.G., Stuttgart (Germany, F.R.)). 1984. 55p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number TI85770057.

From IKE colloquium on energy and environment; Stuttgart, F.R. Germany (20 Jan 1984).

Symptoms of the damage and the presumable causes for the large-scale dying of fir trees and spruces are described. Then the study looks into the production of nitric oxide in engines as nitric oxides are among others held responsible for acid rain and photooxidants; the study is further concerned with emission-reducing measures such as lean-mixture operation, exhaust gas recirculation and exhaust-gas treatment in catalysers, target conflicts with regard to increased energy/fuel consumption. The financial burden for the vehicle owner in case unleaded fuels and catalysers are introduced is mentioned. Survey of: legislation in the USA and Europe on exhaust gas of automobiles, on the test cycles used, environmentally relevant problems that arise if US-exhaust gas regulations are transferred to Europe. Risks for the frontier traffic and the danger of losing jobs are pointed out as consequences that could arise out of isolated national move of the Federal Republic in the direction of environmental protection.

9045 (CONF-8402109—) Pollutants in the environment. (Hohenheim Univ., Stuttgart (Germany, F.R.). Dokumentationsstelle; Hohenheim Univ., Stuttgart (Germany, F.R.). Inst. fuer Landeskultur und Pflanzenoekologie). 1984. 219p. (In German). NTIS (US Sales Only), PC A10/MF A01. File Number TI85770063.

From Environmental meeting on pollutants in the environment; Stuttgart, F.R. Germany (10 Feb 1984).

The proceedings volume contains 20 lectures describing the occurrence, the analysis and the behaviour of various environmental pollutants, mainly of heavy metals, chlorinated hydrocarbons, fluorides etc.

9046 (CONF-8404199—, pp vp) Gaseous and powdery mercury obtained with refuse combustion. Reimann, D.O. 1984. (In German). NTIS (US Sales Only), MF A01. File Number TI85770037.

From 4. colloquium on waste management; Saarbruecken, F.R. Germany (26 Apr 1984).

The mercury content of a feed material (input) can be established most accurately via the sum of different individual outputs of solid, liquid and gaseous residues with the precondition of accurately defined measuring methods. About 10% of the mercury content in refuse remains attached to residual products in a dust-like form with the usual combustion temperatures of 800° to 1,000°C. 90% obtain in a gaseous form and constitute the proportion difficult to treat. The content of gaseous mercury is reduced by a close combination of fluegas temperature reduction and bonding to a carrier medium with a liquid strongly acid product being best suited to this end. Degradation rate of the mercury increases to over 90% when treated with acid water in fluegas scrubbing. Precipitation of mercury from the fluegas washings has proved its great value.

9047 (DOE/OR/21400—2) Changing pattern of fossil fuel CO_2 emissions. Rotty, R.M.; Marland, G.; Treat, N. (Oak Ridge Associated Universities, Inc., TN (USA)). Sep 1984. Contract AC05-76OR00033. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85000417.

Calculations of global CO_2 emissions using fossil fuel production data have demonstrated that the annual emissions rate grew at a rate of 4.5% per year before 1973 and about half that rate after 1973. However, in projecting future emissions, fuel consumption rather than production data should be considered. World population and economic growth (and hence energy demand) are not the same in all parts of the world, and consequently future fuel consumption patterns are likely to be significantly different from those of today. In this analysis the world was divided into six fuel-consuming regions, and for each region growth in CO_2 emissions during the past three decades was carefully analyzed. Not only have fossil fuel CO_2 emissions from the developing nations been growing at a higher rate than those from the developed world, but the developing nations do not show the reduction in growth rate evident in the data for North America, Western Europe, and Japan following 1973. Data for nations with centrally planned economies do not show steady growth rates during either 1950 to 1973 or 1973 to 1980, nor is the typical discontinuity of 1973 evident. Rather the emission growth rate decreased steadily during the entire three decades - each year the increase over the previous year became proportionally smaller. Discontinuities evident in data for the Peoples Republic of China appear to coincide with times of major change in governmental policies. For the next few decades increases in atmospheric CO_2 concentrations will be largely determined by fuel policies in the developed nations of the world, but before the middle of the next century, fuel policies of the rapidly growing nations will become extremely important, if not dominant, in the world CO_2 picture. 9 references, 9 figures, 1 table.

9048 (EPA/600/8—83-016AF, pp 6.1-6.80) Precipitation scavenging processes. Hales, J.M. (Pacific Northwest Laboratories, Richland, WA). Jul 1984. US Environmental Protection Agency, Office of Research and Development, Washington, DC 20460.

In Acidic deposition phenomenon and its effects: critical assessment review papers. Vol. I. Atmospheric sciences.

An overview is presented of meteorological processes which contribute to the wet removal of pollutants from the atmosphere. This is accomplished by first breaking down the scavenging process into a number of discrete steps, and then scrutinizing the associated physical mechanisms or individual and collective bases. The importance of storm type and meteorological behavior on scavenging pathways is emphasized. Field studies of precipitation scavenging and precipitation-scavenging models are presented using equations to facilitate the general discussion. The author concludes with an examination of predictive uncertainties, and the scientific advances which will be necessary to reduce these uncertainties to an acceptable level.

9049 (NP—5770052) Results of aerological ozone measurements and ozone measurements near the ground in the first half of 1983. (Deutscher Wetterdienst, Hohenspeissenberg (Germany, F.R.). Meteorologisches Observatorium). 1984. 190p. (In German and English). NTIS (US Sales Only), PC A09/MF A01. File Number TI85770052.

Instrumental Equipment: Ozonesondes: Brewer-Mast (730/8), preflight preparations. Radiosondes: VIZ 1392, if possible with hypsometer (1393); Receiving equipment: Radiotheodolite GMD-2 (1693 MHz), data recorder TMQ-5. The launching site is within the Observatory's ground (976 m MSL). The GMD-2 is located 800 m eastwards. Balloons: 2000 g TOTEX. Data Processing of the Sondes: The radiosonde data are not corrected. The ozonesonde data (transmitted over 4 seconds alternating with the radiosonde) are normally corrected by an actual total ozone measurement at the station. Total Ozone Measurement: If possible daily DS-measurements (C/AD-wavelength) made by the Dobson spectrophotometer No. 104 situated at the tower of the Observatory (30 m above ground). Measurement of Ozone near the Ground: Measured by a wet chemical (potassium-iodide) sensor Hp, a chemiluminescent and an optical instrument (25 m a. ground).

9050 (PB—84-242650) Control technology assessment of hazardous waste disposal operations in chemicals manufacturing: indepth survey report of Tennessee Eastman Company, Kingsport, Tennessee. Anastas, M. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jan 1984. 43p. (CT—103-19B). NTIS, PC A03/MF A01.

See also PB84-242643.

An in depth survey was conducted to assess control technology at the hazardous waste disposal operations of Tennessee Eastman Company (SIC-2800), Kingsport, Tennessee in November 1982. Personal and general air samples were analyzed for organic solvents at various sites. Low concentrations of acetic acid (64197), toluene (108883), and acetone (67641) were detected. The design of the incineration facility contained features for the prevention of spills and leaks, fires, and explosions. The features consisted of interlocks and alarms, specialized instrumentation and equipment that detected leaks and spills of liquid wastes, general ventilation in solid wastes storage area, a kiln overpressure relief vent, and a safety belt for workers disposing of fiberglass and sample bottles. Workers at the kiln routinely maintained records on all hazardous wastes that were stored or disposed of. Recordkeeping made possible the separation of incompatible wastes. Frequent routine inspections of safety and process equipment were conducted. Good work practices were observed. These were attributed in part to the development of a training manual for workers at the site.

9051 (PB—85-100030/XAD) Acidic deposition phenomenon and its effects: critical assessment review papers. Volume 1. Altshuller, A.P.; Linthurst, R.A. (North Carolina State Univ., Raleigh (USA)). Sep 1984. 787p. NTIS, PC A99/MF E03.

See also PB84-171644, and PB85-100048.

This document is a review and assessment of the current scientific knowledge of the acidic deposition phenonemon and its effects. The areas discussed include both atmospheric (Volume I) and effects (Volume II) sciences. Specific topics covered are: natural and anthropogenic emissions sources; transport and transformation processes; atmospheric concentrations and distributions of chemical substances; precipitation scavenging and dry deposition processes; deposition monitoring and modeling; and effects of deposition on soils, vegetation, aquatic chemistry, aquatic biology, materials and human health, indirectly through ingested food or water. Each of the above topics is reviewed in detail using the available literature, with emphasis on U.S. data, and where possible, conclusions are drawn based on the available data.

9052 (PB—85-102879/XAD) Air emissions from industrial boilers burning hazardous waste materials. Olexsey, R.A. (Environmental Protection Agency, Cincinnati, OH (USA). Industrial Environmental Research Lab.). Sep 1984. 19p. (EPA/600—D-84/233). NTIS, PC A02/MF A01.

Hazardous waste incinerators are tightly regulated under the Resource Conservation and Recovery Act (RCRA). On the other hand, processes for which the primary purpose is production of energy but, incidentially, burning hazardous wastes are exempt from the RCRA incineration regulations. EPA is concerned about the impact of this 'Energy Exemption' and has initiated a test program to determine if and to what extent regulation of such processes may be required. The most significant practice that currently is excluded from regulation is disposal of hazardous materials in industrial boilers. There are currently in the U.S. approximately 240,000 operating industrial boilers and a large percentage of these boilers are accessible to hazardous wastes. This paper describes the testing of 12 such industrial boilers of various types using varying waste materials and test 'spiked' materials. Test site selection is discussed, sampling and analytical methodologies are presented and test results are summarized. The primary focus of the test program was on the ability of the boilers to destroy principal organic hazardous compounds (POHCs) and also to characterize and quantify emissions of products of incomplete combustion (PICs). Measurements of particulate emissions, CO, NOx, and THC were also recorded. Attempts were made to establish correlations between boiler type, boiler operating parameters and waste destruction efficiencies.

9053 (PNL—3656) Atmospheric studies in complex terrain: a planning guide for future studies. Orgill, M.M. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1981. Contract AC06-76RL01830. 343p. (ASCOT—80/4). NTIS, PC A15/MF A01; 1; GPO Dep. File Number DE85004646.

The objective of this study is to assist the US Department of Energy in Conducting its atmospheric studies in complex terrain (ASCOT0 by defining various complex terrain research systems and relating these options to specific landforms sites. This includes: (1) reviewing past meteorological and diffusion research on complex terrain; (2) relating specific terrain-induced airflow phenomena to specific landforms and time and space scales; (3) evaluating the technical difficulty of modeling and measuring terrain-induced airflow phenomena; and (4) avolving severdal research options and proposing candidate sites for continuing and expanding field and modeling work. To evolve research options using variable candidate sites, four areas were considered: site selection, terrain uniqueness and quantification, definition of research problems and research plans. 36 references, 111 figures, 20 tables.

9054 Parallel flow diffusion battery. Yeh, H.C.; Cheng, Y.S. (to Dept. of Energy). US Patent 4,463,595. 7 Aug 1984. Filed date 16 Feb 1983. vp.

PAT-APPL-466992.

A parallel flow diffusion battery for determining the mass distribution of an aerosol has a plurality of diffusion cells mounted in parallel to an aerosol stream, each diffusion cell including a stack of mesh wire screens of different density.

5003 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 5003008412, 8417, 9063, 9083, 9141

9055 (AD—357968/7/XAD) Contact radiation hazard associated with aircraft contamination by early cloud penetrations. Banks, J.E.; Dick, J.L.; Pinson, E.A. (Air Force Special Weapons Center, Kirtland AFB, NM (USA)). 18 May 1959. 38p. NTIS, PC A03/MF A01.

Report on Operation Redwing, Proj. 2.66b.

The contact hazard which personnel experience when working on radioactively contaminated aircraft was investigated. Measurements of the contact hazard are approximated by surveying the aircraft with a gamma survey instrument (T1B) and applying a correction factor to the readings obtained; 110 times the T1B reading (r/hr) will give the approximate contact dose (rep/hr) to the skin in areas of direct impingement of the contaminant, i.e., leading edge of the wing, nose, etc., whereas 40 times the T1B reading is applicable to the sliding surfaces, i.e., sides of the fuselage. The protection to an individual from the contact hazard realized by wearing gloves was also investigated. All gloves tested reduced the radiation intensity to the hands by at least 50% in addition to preventing the contaminant from coming in direct contact with the skin. Wearing of gloves in radiation fields of 0.1 r/hr or more is recommended.

9056 (DOE/CS/20458—T1) Effect of weatherization on radon levels in Maine dwellings. Hess, C.T.; Hill, R.C. (Maine Univ., Orono (USA)). 1984. Contract AC01-77CS20458. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85005210.

A study of radon concentration in the air of 30 Maine dwellings was performed before and after weatherization during November 1982-May 1983. The average radon (.75 pCi/1) was lower than a group of houses in a previous study in October 1980-May 1981 (3.1 pCi/1). The after-weatherization levels show an increase over the before-weatherization levels. Trailers were found to have lower radon concentrations than houses. The maximum value measured was 3.2 pCi/1 before and 6.2 pCi/1 after correction for season of exposure. 13 references, 5 figures, 3 tables.

9057 **(EML—433) Estimates of fallout from Nevada weapons testing in the western United States based on gummed-film monitoring data.** Beck, H.L. (USDOE Environmental Measurements Lab., New York). Oct 1984. 141p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85004136.

Estimates of ^{137}Cs depositions from Nevada atmospheric nuclear weapons testing at the Nevada Test Site are presented for 25 sites in Nevada, Utah, California, Arizona, New Mexico, Idaho, Colorado, and Wyoming. These estimates are based primarily on a reappraisal of total beta deposition measured with gummed-film directly after the tests. Maps of the estimated ^{137}Cs deposition at the gummed-film and other sites in the study region are presented to indicate the approximate fallout pattern for each test. The data presented provide reasonable estimates of the relative fallout at a given site from test to test, as well as the relative fallout from site to site for a given test. Absolute deposition estimates, although less certain, are nevertheless in excellent agreement with estimates from other sources. The data are intended for use in documenting which Nevada Test Site shots produced the observed fallout in a given area, thus allowing more accurate population dose estimates to be made from the results of an ongoing program of retrospective soil analyses. The data also provide valuable benchmarks for verifying meteorological model predictions of nuclear debris transport and deposition from individual tests, as well as an additional independent source of information on the general pattern and intensity of Nevada Test Site fallout in the western US. 43 references, 5 figures, 9 tables.

9058 **(KFK—3418) Occurrence and behaviour of Tc in the environment.** Luxenburger, H.J.; Schuettelkopf, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Sicherheit). Aug 1984. 56p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number TI85750475.

A literature research was performed about the occurence and the behaviour of Tc in the environment. About 3600 publications, published between 1925 and 1983, were evaluated. The actual knowledge about Tc in the environment within extended regions is fragmentary. A lot of necessary informations about the behaviour of Tc in the environment are lacking completely.

9059 **(RFP—3633) Wind resuspension of trace amounts of plutonium particles from soil in a semi-arid climate.** Langer, G. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1984. Contract AC04-76DP03533. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003910.

This study of resuspension of soil containing minute amounts of plutonium (Pu-239) has been in progress at the Rocky Flats (RF) Plant since 1978. It is one of several studies initiated after wind relocated small amounts of soil-borne Pu-239 during cleanup of an outdoor storage area. The Pu-239-settled field is now sparsely covered with prairie grass typical of the area. Past studies were limited to comparisons of bulk soil activity with total activity in the airborne dust. This work covers the physics of the particle resuspension process. This report covers the following: (1) Pu-239 resuspension rate versus wind speed, (2) mechanisms of soil particle resuspension, (3) vertical concentration profile of Pu-239 particles, (4) Pu-239 and host particle size distribution and activity concentration. 5 references, 1 table.

5005 Site Resource And Use Studies

9060 **(EFN-LET—1983-22) Wave data and wave effect of Swedish coastal seafaring waters.** Wahl, G. (Energiforskningsnaemnden, Stockholm (Sweden)). 1983. 126p. (In Swedish). NTIS (US Sales Only), PC A07. File Number TI85750449.

The report presents a compilation of wave data from October 1978 to June 1982 performed by the Swedish Meteorological and Hydrological Institute at five measuring stations along the coast. Different wave parameters and wave statistics have been treated. A preliminary study of wave spectra and of long-time distribution of maximum waves has been performed. The effect of a simple wave power plant has been calculated.

5006 Regulations

REFER ALSO TO CITATION(S) 5006008419, 8676, 9044

9061 **(GAO/RCED—84-201) Status of EPA's air quality standards for carbon monoxide.** (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 27 Sep 1984. 49p. US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760. File Number TI85900442.

Report to The Chairman, Subcommittee on Oversight and Investigations, Committee on Energy and Commerce, House of Representatives.

The Clean Air Act requires the Environmental Protection Agency (EPA) to establish, and periodically review and revise national air quality standards. EPA established standards for carbon monoxide in 1971 and in August 1980 proposed updated revisions to those standards. Seven of the eight key studies EPA used to support the revisions were authored by a cardiologist employed by the Veterans Administration. In March 1983 EPA was about to issue its revised standards when it learned that the cardiologist had been under investigation by the Food and Drug Administration and the Veterans Administration since 1979 for, among other things, alleged falsification of research. As a result, EPA delayed issuing the standards, conducted an audit of the research data, and concluded that it could not rely on the cardiologist's research. Even without this research, EPA believes that there is a sufficient scientific basis to support revised standards but has not yet decided what those standards will be.

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 5102008209, 8210, 8211, 8293, 8422, 9045, 9051

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 5103008412, 8414, 8423, 9058, 9059, 9083

9062 **(PB—84-240175) Environmental radionuclide concentrations in the vicinity of the Peach Bottom Atomic Power Station: 1979-1980.** McLean, R.I.; Magette, T.E.; Zobel, S.G. (Maryland Dept. of Natural Resources, Annapolis (USA). Power Plant Siting Program). Jan 1983. 32p. NTIS, PC A03/MF A01.

The Power Plant Siting Program conducts radiological analyses of environmental samples collected from the Susquehanna River and Upper Chesapeake Bay. These studies were initiated in 1979 to determine the radioecological impact of the Three Mile Island Nuclear Station and the Peach Bottom Atomic Power Station on the Maryland environment. Collections of sediments, finfish, shellfish, aquatic mammals, aquatic vegetation and waterfowl were analyzed by high-resolution gamma spectroscopy to determine gamma-emitting radionuclide concentrations. Analytical results and interpretation of studies conducted during 1979-1980 are presented herein. In addition to naturally occurring radionuclides (Potassium-40, thorium and uranium decay products) and weapons-test fallout radionuclides (principally Cs-137 and Ce-144), low levels of Cobalt-60, Zinc-65, Cesium-134 and Cesium-137 attributed to the Peach Bottom facility were detected in biota and sediments of the Conowingo Pond, Susquehanna River and Susquehanna Flats.

9063 **(RFP—3647) Analysis of resuspension source area impacts at Rocky Flats surveillance air samplers S-7 and S-8, July 25-August 25, 1983 and September 8-October 4, 1983.** Hammer, R.J. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). Jan 1984. Contract AC04-76DP03533. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004060.

An on-going study at the Rocky Flats Plant is being used to evaluate resuspension source area contributions to Pu-239 concentrations at 2 of the samplers in the Plants air sampling network. Early results from the study indicate that Pu-239 concentration levels are being affected primarily by resuspension from a zone 150 meters east and west of the study samplers. Initial results have also shown that net transport of Pu-239 during the sampling period has been from the east toward the west, onto the plant proper. These early findings show that sources immediately east of the 2 samplers are responsible for most of the Pu-239 exposure at the samplers. 2 references, 1 figure, 4 tables.

5105 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 5105008407, 8421

9064 **(FWS/OBS—84/10) Endangered and threatened species on US Air Force installations.** Howard, R.; Perry, A.; Herring, P. (Air Force Engineering and Services Center, Tyndall AFB, FL (USA); Fish and Wildlife Service, Slidell, LA (USA). National Coastal Ecosystems Team). Aug 1984. 143p. NTIS, PC A07/MF A01. File Number TI85900739.

This report provides information on endangered and threatened species of plants and animals that occur or may occur on US Air Force properties. (ACR)

9065 **(PB—84-236876) Seasonal abundance and habitat-use patterns of coastal bird populations on Padre and Mustang Island barrier beaches, (following the Ixtoc I oil spill).** Chapman, B.R. (Corpus Christi State Univ., TX (USA). Dept. of Biology). Feb 1984. 87p. NTIS, PC A05/MF A01.

Library of Congress catalog card No. 84-601060. Sponsored in part by Minerals Management Service, Washington, DC.

The report assesses the impact of the Ixtoc I oil spill on coastal bird populations and provides baseline information about the distribution and seasonal abundance of the avian species that use south Texas beach and nearshore habitats. The report synthesizes all available data on waterbirds in the study area, including censuses made from October 1979 through June 1981. The section on results and discussion describes the annual, seasonal, and daily cycles of avian abundance, distribution, and diversity. The species profiles sections provide distribution, status, seasonal abundance, habitat-use patterns, and oil vulnerability information for 26 species.

9066 **(PB—84-246388) Flue gas desulfurization sludge: establishment of vegetation on ponded and soil-applied waste. Final report January 1977-September 1981.** Giordano, P.M.; Mays, D.A.; Soileau, J.M. (Tennessee Valley Authority, Muscle Shoals, AL (USA). Div. of Energy Demonstrations and Technology). Jan 1984. 32p. (TVA/OP/EDT—82/23). NTIS, PC A03/MF A01.

The report gives results of research to identify and evaluate forms of vegetation and methods of their establishment for reclaiming retired flue gas desulfurization sludge ponds. Also studied were the soil liming value of limestone scrubber sludge (LSS) and plant uptake and percolation losses of some chemical nutrients in the sludge. Several vegetation schemes were evaluated between 1977 and 1982 for covering and stabilizing LSS at Colbert Steam Plant, Cherokee, AL, and Shawnee Steam Plant, Paducah, KY. Eleven tree and 10 grass or legume species were tested for adaptability and survival when planted directly in LSS or in LSS amended with soil, municipal sewage sludge, or standard potting mix. Other studies indicated that LSS apparently has sufficient unreacted limestone to be a satisfactory soil liming agent.

52 ENVIRONMENTAL SCIENCES, AQUATIC

5201 Basic Studies

REFER ALSO TO CITATION(S) 5201008953

9067 **(DOE/EV/00639—26) Production and turnover of suspended organic detritus in the coastal water of the southeastern continental shelf. Progress report.** Pomeroy, L.R. (Georgia Univ., Athens (USA). Inst. of Ecology). 1 Dec 1984. Contract AS09-76EV00639. 122p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85003977.

Data processing from the GABEX II study of 1981 have been completed, and manuscripts are nearing completion at this time. In April, 1985, we will participate in the study of removal of coastal water from the continental shelf (SPREX). Our role will be to follow the movement and degradation of particulate organic matter as it is transported across the shelf by wind-driven mixing events. Total suspended C and N will be measured, as well as production of bacteria and numbers of bacteria and protozoa. In preparation from SPREX, we are developing a sensitive method for measuring microbial respiration in the water. Beginning in the summer of 1985, we will participate in a series of studies of the biological processes in the coastal water off the coast of Georgia (BIOTRANS). In preparation for that we are developing a system for following production and degradation of particles in a large water sample under laboratory conditions. This will, of course, be supplemented by field observations. To evaluate the suspension of particulate matter of benthic origin we are constructing an annular flume in which box cores of bottom sediment will be inserted to measure the shear stress necessary to resuspend naturally produced materials. We are continuing field and laboratory studies of the roles of bacteria in the production, as well as the utilization of particulate organic materials. The production of macroflocs has been shown by us to involve the adherence of bacteria to particles and to each other. The macroflocs do not develop in sterile conditions.

9068 **(DOE/EV/03801—T3) Effects of energy related activities on the stress-sensitive microbial processes in mangrove detrital food webs.** Fell, J.W. (Miami Univ., FL (USA). Rosenstiel School of Marine and Atmospheric Sciences). [1984]. Contract AS05-76EV03801. 18p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004331.

Nutrient flows from leaf litter decomposition are evaluated in terms of their contributions to the ecosystem. The roles of the stress sensitive microbial processes are being determined. Emphasis is on the following aspects: (1) nitrogen immobilization; (2) transport of particulate carbon to the estuary; (3) role of flocculent materials produced from leachates; (4) invertebrate utilization of carbon and nitrogen flows; and (5) possible effects on these systems if the Gulf oil spill reaches the south Florida coast. 19 references. (ACR)

9069 **(DOE/EV/03801—T4) Role of fungi in carbon flow and nitrogen immobilization in coastal marine plant litter systems.** Fell, J.W.; Newell, S.Y. (Miami Univ., FL (USA). Rosenstiel School of Marine and Atmospheric Sciences). [1984]. Contract AS05-76EV03801. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004332.

This review presents some of the direct and indirect evidence that implicates fungi in the decomposition of coastal plant litter with the hope of stimulating further research in an area that is vital to understanding of marine food webs. 86 references.

9070 **(DOE/EV/03801—T7) Mangrove detrital system: decomposition processes and their role in estuarine food webs.** Fell, J.W. (Miami Univ., FL (USA). Rosenstiel School of Marine and Atmospheric Sciences). 1978. Contract AS05-76EV03801. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004335.

The report describes a research program directed to the role of the decomposition of leaf material from the red mangrove (Rhizophora mangle) in the food web of estuaries, how these processes

work and what alterations can be expected with environmental perturbations. The program was designed to examine the following components of the decomposition process involving carbon and nitrogen inputs/outputs: (1) the role of nitrogen fixation in the decomposition process; (2) the role of fungi in the secondary phase of decomposition; (3) the fate of detrital particles via $^{13}C/^{12}C$; (4) the role leachates in food webs; and (5) invertebrate utilization of detritus. 19 references. (ACR)

9071 **(DOE/EV/03801—T8) Laboratory model of the potential role of fungi (Phytophthora spp.) in the decomposition of red mangrove (Rhizophora mangle) leaf litter.** Fell, J.W.; Master, I.M.; Newell, S.Y. (Miami Univ., FL (USA). Rosenstiel School of Marine and Atmospheric Sciences). 1977. Contract AS05-76EV03801. 23p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004336.

Field studies of quantitative changes in carbon, nitrogen and dry weight of decomposing mangrove leaves demonstrated similar net weight and carbon losses irrespective of station location or time of year. In contrast, rates differed and percent change in nitrogen content varied from no gain to 78% increase. A laboratory model was designed to examine the field responses. Because of variation between leaves, a split leaf technique was developed in which one half of the leaf was used to predict the original carbon, nitrogen and dry weight of the other, experimental, half leaf. Nitrogen immobilization, in the laboratory studies, required the presence of microorganisms, such as fungi of the genus Phytophthora, and the addition of inorganic N. The final amount of nitrogen in the leaf was directly related to the original amount, however, change in nitrogen was inversely related to original nitrogen. Weight loss was inversely related to the dry weight:fresh weight ratio of the leaves, possibly due to the high fiber content of the high ratio leaves. A discussion is presented of the field results, as interpreted by the laboratory model. 28 references, 15 figures, 1 table.

9072 **(DOE/EV/03801—T9) Dry matter, carbon, and nitrogen content of decomposing rush and mangrove leaves in south Florida.** Newell, S.Y.; Fell, J.W.; Tallman, A.S. (Miami Univ., FL (USA). Rosenstiel School of Marine and Atmospheric Sciences). 1978. Contract AS05-76EV03801. 38p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85004337.

The fundamental physicochemical changes which take place within decaying leaves of two important marsh plants of south Florida, black needle rush (Juncus roemerianus Scheele) and red mangrove (Rhizophora mangle L.), are described. The purpose was to investigate nutrient transfer phenomena, which occur in coastal fringing marshes. 94 references, 2 figures, 2 tables. (ACR)

9073 **(DOE/EV/03801—T10) Fungi associated with the decomposition of the black rush Juncus roemerianus in south Florida.** Fell, J.W.; Hunter, I.L. (Miami Univ., FL (USA). Rosenstiel School of Marine and Atmospheric Sciences). 1978. Contract AS05-76EV03801. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004338.

To determine what fungi are associated with the decomposition process and what affects certain environmental and sampling variables have on the observed fungal community structure, the fungi associated with Juncus roemerianus in a subtropical environment were examined. A total of 123 fungal taxa was observed on Juncus roemerianus leaves. Thirty-four taxa were at a frequency of occurrence of 1% or more. Of these, 5 taxa (Fusarium spp., Cladosporium cladosporioides, Drechslera hawaiiensis, Alternaria alternata and Geniculosporium sp.) were in excess of 25%. The observed community structure was affected by the condition of the leaf (living, senescent or decomposing leaves), position on the leaf (tip, middle or base of the leaf), season of the year (wet vs dry season) and culture technique. Of less significance was station location within the study site. Comparisons with other studies of Juncus and red mangrove (Rhizophora mangle) litter indicated a distinct fungal community structure associated with Juncus in subtropical estuarine environments. 29 references, 10 tables. (ACR)

9074 **(DOE/EV/03801—T11) Community structure and estimated contribution of primary consumers (Nematodes and Copepods) of decomposing plant litter (Juncus roemerianus and Rhizophora mangle) in South Florida.** Fell, J.W.; Cefalu, R. (Miami Univ., FL (USA). Rosenstiel School of Marine and Atmospheric Sciences). [1984]. Contract AS05-76EV03801. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004339.

The paper discusses the meiofauna associated with decomposing leaf litter from two species of coastal marshland plants: the black needle rush, Juncus roemerianus and the red mangrove, Rhizophora mangle. The following aspects were investigated: (1) types of meiofauna present, especially nematodes; (2) changes in meiofaunal community structures with regard to season, station location, and type of plant litter; (3) amount of nematode and copepod biomass present on the decomposing plant litter; and (4) an estimation of the possible role of the nematodes in the decomposition process. 28 references, 5 figures, 9 tables. (ACR)

9075 **(GSF-R—369) Development of single-well techniques for quantitative ground water studies.** Bachmat, Y.; Bugayevsky, M.; Mandel, S.; Behrens, H.; Drost, W.; Klotz, D.; Moser, H. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Radiohydrometrie). Feb 1984. 85p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE85750072.

The signle-well pulse technique was modified in such a manner that the dispersivity of the ground water bearing strata can be derived from the measured results. An outline of the theoretical fundamentals is followed by solutions to apparative problems, i.e. tracer selection (Br-82, colour), set-up of measuring points, etc.. The method was tested in the laboratory and in a test field. Suitable, quick methods of evaluation were developed and the technical equipment was optimized for routine application. The method was tested in wells in Israel.

9076 **(PB—85-107621/XAD) Benthic primary production in the Columbia River Estuary. Final report.** McIntire, C.D.; Amspoker, M.C. (Oregon State Univ., Corvallis (USA)). Feb 1984. 150p. NTIS, PC A07/MF A01.

Sponsored in part by Columbia River Estuary Study Taskforce, Astoria, OR and National Oceanic and Atmospheric Administration, Rockville, MD.

The general objective of the research associated with the Benthic Primary Production Work Unit of Columbia River Estuary Development Program was to determine mechanisms that control the production dynamics and species composition of benthic plant assemblages in the Columbia River Estuary. In particular, the work was concerned with effects of selected physical variables on structural and functional attributes of micro- and macro- vegetation, and on the productivity and biomass of benthic autotrophs on the tidal flats of the estuary.

9077 **Recent advances in instrumentation in deep-sea biological research.** Rowe, G.T.; Sibuet, M. pp 81-95 of Sea. Vol. 8. Rowe, G.T. (ed.). New York, NY, USA; John Wiley and Sons, Inc. (1983).

New developments in instrumentation are discussed that can be used universally to measure rates of biological processes as they occur in the deep sea. The developments have been due to the utilization of submersibles and remote vehicles with manipulators, free vehicles with timed and acoustic releases, seafloor acoustic navigation systems, and pressure-retrieval systems. Photography and its applications in the deep sea are also discussed. Combinations of these systems allow experiments on rates of processes and small-scale dispersion to be conducted successfully.

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 5202008112, 8160, 8210, 8211, 8295, 8297, 8873, 9045, 9051, 9068

9078 (DOE/MC/16552—T1) Evaluation of groundwater contamination due to leakage from a process waste storage pond and a plan for recovering the site. Final technical report. Glass, J.P.; Gidley, J. (West Virginia Univ., Morgantown (USA). Dept. of Civil Engineering). Feb 1983. Contract AT21-81MC16552. 96p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85001287.

In 1975 an open holding pond with a nominal capacity of 1 million gallons was constructed at the Morgantown Energy Technology Center (METC) to contain liquid process wastes generated by the research in coal gasification being conducted there. This report contains the results of a study to investigate the amount of groundwater contamination that may have occurred in the area and to draft a plan for the environmentally safe recovery of the site. The project consisted of 4 tasks: (1) Installation and operation of a groundwater system in the vicinity of the pond; (2) Analysis of groundwater quality and movement in the vicinity of the holding pond; (3) Mitigating groundwater contamination; and (4) Recovery of the lagoon area. The accomplishment of the above tasks was impaired in varying degrees by the unfortunate lack of success in arranging the installation of the groundwater monitoring system specified under Task 1. Since these wells were never constructed it became necessary to rely on a variety of secondary data sources, including the following: (1) Logs of old wells and exploratory borings on and near the METC property. (2) Data from the existing but unsatisfactory monitoring wells near the waste storage pond. (3) Analyses of groundwater samples collected in seepage pits along the banks of the gully lying to the west of the pond. (4) Water balance computations based on inflow and outflow measurements at the pond. (5) Observations and samples from a series of shallow auger holes bored by hand around the periphery of the pond. Ground water was analyzed for phenol, chromium, lead, cadmium, vanadium, chlorides, and chemical oxygen demand. 41 figures, 10 tables. (DMC)

9079 (PB—84-243906) Data acquisition for environmental transport and fate screening for compounds of interest to the Office of Solid Waste. Jaber, H.M.; Mabey, W.R.; Liu, A.T.; Chou, T.W.; Johnson, H.L. (SRI International, Menlo Park, CA (USA)). Feb 1984. 147p. NTIS, PC A07/MF A01.

See also PB84-243955.

Physical properties, equilibrium, and kinetic constants for evaluating the transformation and transport in aquatic systems for organic chemicals of interest to the US Environmental Protection Agency's Office of Solid Waste during FY 1983 have been obtained from the literature and calculated from theoretical or empirical relations. Values for selected physical properties such as melting point, boiling point, vapor pressure, water solubility, and octanol/water partitioning, and for rate constants such as hydrolysis, microbial degradation, photolysis, and oxidation are listed for each chemical along with the source of the data. Values are reported in units suitable for use in a current aquatic fate model. A discussion of the empirical relationships between water solubility, octanol/water partition coefficients, and partition coefficients for sediment and biota is presented.

9080 (PB—84-243955) Data acquisition for environmental transport and fate screening. Jaber, H.M.; Mabey, W.R.; Liu, A.T.; Chou, T.W.; Johnson, H.L. (SRI International, Menlo Park, CA (USA)). Feb 1984. 312p. NTIS, PC A14/MF A01.

See also PB84-243906.

Physical properties, equilibrium, and kinetic constants for evaluating the transformation and transport in aquatic systems for organic chemicals of interest to the US Environmental Protection Agency's Office of Solid Waste have been obtained from the literature and calculated from theoretical or empirical relations. Values for selected physical properties such as melting point, boiling point, vapor pressure, water solubility, and octanol/water partitioning, and for rate constants such as hydrolysis, microbial degradation, photolysis, and oxidation are listed for each chemical along with the source of the data. Values are reported in units suitable for use in a current aquatic fate model. A discussion of the empirical relationships between water solubility, octanol/water partition coefficients, and partition coefficients for sediment and biota is presented.

9081 (PB—85-100378/XAD) Water quality in Iowa. (Iowa Dept. of Water, Air and Waste Management, Des Moines (USA)). May 1984. 118p. NTIS, PC A06/MF A01.

The surface and ground water quality in Iowa is identified for 1981-1983. The discussion of surface water includes information about surface water resources and water quality conditions, as affected by point and nonpoint sources, conventional and toxic pollutants. The discussion of ground water includes geologic features, the Iowa ground water system and water quality. The sources of pollutants affecting our waters and the activities to control these sources are identified. Data acquisition programs in Iowa conducted by state and federal agencies are reviewed.

9082 (PB—85-107076/XAD) Report to the Congress on ocean pollution, monitoring and research, October 1982 through September 1983. (National Oceanic and Atmospheric Administration, Washington, DC (USA)). Jul 1984. 79p. NTIS, PC A05/MF A01.

See also PB84-104231.

This report summarizes activities of the Ocean Assessments Division (OAD), Office of Oceanography and Marine Services, National Ocean Service, National Oceanic and Atmospheric Administration (NOAA), performed during fiscal year 1983. The OAD conducts a comprehensive, continuing program of assessment activities, including research, development, and monitoring, on the short- and long-term effects of human activities on the marine environment. These activities result in information products and services useful for planning and decision making related to the resolution of multiple resource-use conflicts, including environmental quality problems, in the estuarine, coastal, and oceanic areas of the United States. Ocean waste disposal assessment remained a high priority during fiscal year 1983.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 5203008398, 8412, 8414, 8420, 9058, 9062, 9122

9083 (PB—85-101756/XAD) Environmental Radiation Data report 37, January-March 1984. (Environmental Protection Agency, Montgomery, AL (USA). Eastern Environmental Radiation Facility). Jun 1984. 53p. (EPA/520/5—84/019). NTIS, PC A04/MF A01.

See also PB84-149145.

Environmental Radiation Data (ERD) is compiled and distributed quarterly by the Office of Radiation Programs Eastern Environmental Radiation Facility (EERF), Montgomery, Alabama, and contains data from the Environmental Radiation Ambient Monitoring System (ERAMS). Data from similar networks operated by contributing States, Canada, Mexico, and the Pan American Health Organization are reported in the ERD when available. The ERAMS is comprised of nationwide sampling stations that provide air, surface and drinking water, and milk samples from which environmental radiation levels are derived. The radiation analyses performed on these samples include gross alpha and gross beta levels, gamma analyses for fission products, and specific analyses for uranium, plutonium, strontium, iodine, radium, krypton, and tritium.

53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

5301 Social And Economic Studies

REFER ALSO TO CITATION(S) 5301008415, 8416

9084 **(ANL/EES-TM—268) Analysis of regional demand for natural gas by black and nonblack families.** Poyer, D.A. (Argonne National Lab., IL (USA)). Aug 1984. Contract W-31-109-ENG-38. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004570.

This study examines long-term implications of a hypothetical 20% increase in the price of natural gas for black and nonblack families, by household, in the continental United States. The analysis focuses on four specific effects of such an increase: demand for natural gas, expenditure for natural gas, natural gas expenditure as a share of family income, and consumer surplus. Data are organized geographically to represent three sections of the continental United States - the northeastern states, the north central states, and the southern and western states. (The state groupings are identical to those represented in the country's census regions; the southern and western census regions were combined because of data limitations). The report presents demand equations that were used to estimate gas consumption and expenditure by average black and nonblack families in the three geographic areas. Models representing typical household types, each with a specific set of attributes, are then presented to show average base-year values for natural gas consumption and expenditure for two types of black and nonblack families - those that use natural gas for any purpose and only those that use it for space heating. (Base-period values are estimated using data from a DOE survey conducted in the years 1980 and 1981). The effects of a hypothetical 20% increase in the price of natural gas on the various household types were then estimated. Those effects are summarized. Families using natural gas for a any purpose in the north central states would experience the greatest long-term effects of a 20% price increase. Black families in those states would feel the effects more dramatically than nonblack families. The relative geographic effects of such a price increase change, however, when only those families that use natural gas for space heating are analyzed. 3 references, 4 figures, 18 tables.

5302 Assessment Of Energy Technologies

9085 **(STEV-TFS—84-6) Analysis of health and safety risks connected to energy supplies based on peat, wood fuels, wind and coal.** Ericson, S.O.; Olin, C.; Tollin, J. (Statens Energiverk, Stockholm (Sweden)). Apr 1984. 117p. (In Swedish). NTIS (US Sales Only), PC A06/MF A01. File Number TI85750452.

This report is an analysis of the risks that follow production of energy from coal, peat, wood fuels, energy forest and wind. By the increased use of district heating in densely built up areas, fuel oil will be replaced by soild fuels for heat production. The greatest risks that follow from the use of the energy sources wood fuels, peat, coal and wind that are discussed in this report are: occupational hazards for producing, handling, storing etc, traffic accidents caused by the transport of solid fuels, emissions from the combustion of solid fuels. Our conclusions are that the energy sources studied do not involve more or less risk than many other activities in modern society. The levels of risk will in general be comparable to levels in similar activities, e.g. farm work, forest work, construction work. Transport by rail leads to less accidents than transport by road. However, the difference is small and there will not be a large increase in the amount of transport work due to the energy sources studied. Emissions of SO(sub)x, CO_2, particulates, Ni and V will be reduced. The only significant increase is in emission of mercury, which in Sweden could increase by as much as 10 percent. In view of the effects on the environment, there are no reasons to limit the use of the energy sources discussed. Acidification of water and soil, photochemical oxidants and the possible climate changes, due to carbondioxide in the atmosphere are the only major environmental problems to which the solid fuels make a considerable contribution.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

5502 Biochemistry

REFER ALSO TO CITATION(S) 5502009089

9086 **(BNL—35002) Enzymes and sites of genetic recombination: studies with gene 3 endonuclease of phage T7 and with site affinity mutants of phage lambda.** de Massy, B.; Studier, F.W.; Dorgai, L.; Appelbaum, E.; Weisberg, R.A. (National Inst. of Child Health and Human Development, Bethesda, MD (USA). Lab. of Molecular Genetics; Brookhaven National Lab., Upton, NY (USA); Agrigenetics Corp., Madison, WI (USA)). 1984. Contract AC02-76CH00016. 43p. (CONF-8405223—1). NTIS, PC A03; 3; GPO Dep. File Number DE84015288.

From Cold Spring Harbor symposium on quantitative biology in collaboration with NIH; Cold Spring Harbor, NY, USA (30 May 1984).

The ability of bacteriophage T7 endonuclease I to cleave Holliday structures was investigated. Holliday structures are an intermediate in genetic recombination, and their cleavage is essential for bacteriophage growth. 37 references, 11 figures.

9087 **DNA repair: progress and problems - review.** Painter, R.B. (Univ. of California, San Francisco). pp 205-211 of Proceedings of the 7th international Congress radiation research. Broerse, J.J.; Barendsen, G.W.; Kal, H.B.; van der Kogel, A.J. (eds.). Hague, Netherlands; Martinus Nijhoff (1983). Contract AC03-76SF00012.

An attempt is made to review some of the problems, as well as the successes in DNA repair. Early experimental results firmly established that repair of DNA occurs in both prokaryotic and eukaryotic organisms after exposure to ionizing and UV radiations. However, elaboration of the mechanisms of DNA repair has not come easily. Studies on the excision repair in Escherichia coli have made rapid advances in the past 5 years. For example, work on the rec repair system in E. coli lead to the conclusion that at least two of the uvr genes were inducible and under the control of the rec system. Then, in the past few years, the function and control of the uvr system has become clear. Another interesting development in the study of DNA repair in E. coli is the finding that UV-induce mutagenesis is not passive; the product of a specific gene, umuC, is required.

5504 Genetics

REFER ALSO TO CITATION(S) 5504009086

5505 Metabolism

REFER ALSO TO CITATION(S) 5505009105

5506 Medicine

REFER ALSO TO CITATION(S) 5506009280

9088 **(DOE/ER/60040—T2) Chemoradiotherapy of cancer using boronated monoclonal antibodies. Comprehensive progress report, April 1, 1982-October 31, 1984.** (Ohio State Univ. Research Foundation, Columbus (USA)). 1984. Contract AC02-82ER60040. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003696.

Research to develop boron neutron capture for radiotherapy applications is summarized. Work is reported in the following areas: (1) chemical and biochemical research with $B_{12}H_{11}SH^{2-}$; (2) chemical and protein-binding studies with $B_{12}H_{11}NCO^{2-}$ and $(CH_3)_3NB_{10}H_9NCO^{1-}$; (3) effects of neutron irradiation and capture on phytomitogen stimulated lymphocyte blastogenesis; (4) production and characterization of monoclonal antibodies directed against

the murine B16 melanoma; (5) reactor description and determination of flux profile; (6) determination of neutron profile; (7) improvement of the neutron beam by the bismuth scatterer method; and (8) in vitro sensitivity of B16 melanoma cells to thermal neutrons and $^{10}B(n,\alpha)$ capture. 11 references.

9089 **(DOE/EV/02217—54) Investigation of molecular mechanisms in photodynamic action and radiobiology with nanosecond flash photolysis and pulse radiolysis. Progress report, January 1, 1983-June 30, 1984.** Grossweiner, L.I. (Illinois Inst. of Tech., Chicago (USA)). 1984. Contract AC02-76EV02217. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004376.

Photodynamic therapy (PDT) is a new modality for the treatment of malignant tumors based on the combined action of visible light and a tumor-localizing photosensitizer, hematoporphyrin derivative (HpD). The putative action mechanism involves the attack of singlet oxygen (Δ) on tumeor tissue membranes. Model studies with liposomes have shown that an HpD fraction enriched in the active constituent (HpD-A) photosensitizes membranes lysis and lipid peroxidation. Dialysis measurements showed that HpD-A is 15% free at physiological conditions, compared to 100% binding of hematoporphyrin (HP). The suggested alternate PDT sensitizer, uroporphyrin I (Uro-I), had PHI/sub Δ/ = 0.92 in SUV and sensitized lipid peroxidation. The rate of photobleaching of Uro-I was much faster than HpD-A. Studies with a mouse tumor model showed that encapsulation of HpD in liposomes (SUV) prior to intraperitoneal injection into athymic nude mice carrying implanted human tumors led to a 2-fold increase in HpD uptake by tumors. Liposomal injection led to good response of the tumors (human head and neck mucosal squamous cell carcinoma) to 630 nm radiation from a clinical argon-pumped dye laser. A novel aging transformation of dilute aqueous HP and Uro-I was investigated in which the usual aggregates are converted to a new form with characteristic absorption and emission spectra and photochemical properties. The proposed structure is a linear micelle with the central hydrogens of the free base hydrogens in alternate antiparallel orientation. The aged HP is an efficient photosensitizer of NADP oxidation via its triplet state, which has implications for published theories on the evolution of photosynthesis. 39 references. 10 figures, 10 tables.

9090 **(ORNL/TM—9394) Nuclear medicine progress report for quarter ending September 30, 1984.** Knapp, F.F. Jr.; Ambrose, K.R.; Goodman, M.M.; Srivastava, P.C. (Oak Ridge National Lab., TN (USA)). Dec 1984. Contract AC05-84OR21400. 15p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004766.

The preparation and animal testing of a new radio-iodinated p-iodophenylamine-linked dihydropyridine system is described. The model agent, 1-methyl-3-[N-[β-(4-[^{125}I]iodophenyl)ethyl]carbamoyl]-1,4-dihydropyridine, was prepared by coupling 4-[^{125}I]iodoaniline with the methiodide salt succinimidyl ester of nicotinic acid followed by dithionite reduction to the lipid soluble product. The dihydropyridine agent showed good brain uptake in rats (5 min, 1.14% injected dose/gm; 60 min, 1.12% dose/gm) and good brain to blood ratios (5 min 3.9:1, 60 min, 3.5:1). In contrast the quaternary ammonium compound, prior to reduction, showed only moderate brain uptake (5 min, 0.63; 60 min, 0.46) and low brain to blood ratios (5 min, 0.05; 60 min, 0.06). Also described is further investigation of the effects of fasting on the relative myocardial retention of straight-chain iodovinyl fatty acids. 18-[^{125}]Iodo-17-octadecenoic acid showed good retention in unfasted rats. Studies have now been reported for fasted rats where this agent showed rapid myocardial wash-out. In fasted rats, ~ 70% wash-out at 30 min, and in unfasted rats, ~ 15% wash-out at 30 min was observed. During this period several shipments were made to Medical Cooperative investigators including three samples of ^{191}Os-potassium osmate (Children's Hospital, Boston, and the University of Liege, Belgium) and 15-(p-[^{131}I]iodophenyl)-3-R,S-methylpentadecanoic acid (University of Massachusetts and Brookhaven National Laboratory).

9091 **(PB—85-100543/XAD) Visualization and quantitation of coronary arteries using multiple-view energy subtraction digital radiography. Interim report 30 September 1983-29 September 1984.** Macovski, A. (Stanford Univ., CA (USA)). 27 Aug 1984. 21p. NTIS, PC A02/MF A01.

The authors have studied a general approach to the imaging of coronary arteries using minimally invasive intravenous administration of contrast material. Using conventional DSA techniques this visualization would fail due to motion, low SNR, and intervening iodinated structures. The authors have implemented the digital fluoroscopy system with a rotating gantry and tested it on phantoms. Evaluation of stenosis in coronary arteries is difficult with low SNR images. The authors have studied and implemented a vessel outlining system using a global estimation procedure. The most recent approach has significantly improved computational efficiency. The processing of multiple-energy data to eliminate the moving soft tissue results in a noise penalty. The authors have studied and implemented an approach to restore the original SNR by deriving the high frequency components from a non-selective image. The authors have also implemented a scatter-cancellation system for minimizing this source of error.

5507 Microbiology

REFER ALSO TO CITATION(S) 5507009086

9092 (CONF-8109271—Exc., pp 3.1-3.7) **Influence of anaerobic digestion on the survival of some pathogens in cattle manure.** Hansen, P.; Hansen, S.; Henriksen, Sv.Aa.;Berg Joergensen, J. 1981. NTIS (US Sales Only), PC A05/MF A01. File Number TI85770103.

From 2. international symposium on anaerobic digestion; Travemunde, F.R. Germany (7 Sep 1981).

5509 Pathology

9093 **(NASA-CR—3795) Research opportunities in bone demineralization. Final report, Phase III.** Anderson, S.A.; Cohn, S.H. (eds.). (Federation of American Societies for Experimental Biology, Bethesda, MD. Life Sciences Research Office; Brookhaven National Lab., Upton, NY (USA)). Apr 1984. Contract AC02-76CH00016. 75p. (BNL—35408). NTIS, PC A04/MF A01. File Number TI85005006.

The report comprises an overview of bone demineralization during space flight, observations of the ad hoc Working Group on the NASA Biomedical Research Program in Bone Demineralization and experiments related to bone loss planned for Spacelab flights, and suggestions for further research. The observations of the ad hoc Working Group focused upon the following topics: (1) pathogenesis of bone demineralization, (2) potential for occurrence of renal stones consequent to prolonged hypercalciuria, (3) development of appropriate ground-based and inflight models to study bone demineralization, (4) integration of research efforts, and (5) development of effective countermeasures. Priorities for further research are indicated. 174 references.

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 5530008201, 8735

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

REFER ALSO TO CITATION(S) 5601209107

9094 **(AD-A—145500/5) Assessment of antiradiation drug effectiveness to fission neutron irradiation. Annual report September 1981-August 1982.** Sigdestad, C.P. (Louisville Univ., KY (USA). School of Medicine). Sep 1982. 62p. NTIS, PC A04/MF A01.

This report describes the assays of various compounds for their toxicity and anti-radiation efficacy following exposure to either Co-60 or fission neutron irradiation. The chemicals covered in this report are: WR 347, WR 1065, WR 2529, WR 2721, WR 3689, WR 44923, WR 109342, WR 151327 and WR 168643. The drugs and their respective dose modification factors (DMF) for fission neutron gastrointestinal lethality (LD50-6) following intraperitoneal administration are, in decreasing order of effectiveness: WR 44923 (1.77), WR 2529 (1.47), WR 1065 (1.42), WR 2721 (1.39), WR 16843 (1.23). Following per os (P. O.) administration of the drug, the DMF's for the LD50-6 are: WR 109342 (1.47), WR 3689 (1.36), and WR 168643 (1.31). For hematopoietic neutron radiation lethality (LD50-30) the DMF's are: following i.p. administration, WR 2529 (1.04); WR 151327 (1.34), WR 168643 (1.25), WR 44923 (1.22), WR 2721 (1.20), WR 1065 (1.04); following P. O. administration, WR 168643 (1.38), WR 109342 (1.21), WR 3689 (1.04). Using an intestinal microcolony assay system the following drugs provided the listed DMF's against neutron radiation after i.p. injection: WR 3689 (1.24), WR 2721 (1.15), WR 44923 (1.14), and WR 347 (1.05). The protective effects against neutron radiation using an endogenous spleen colony assay and i.p. administration were: WR 3689 (1.18), WR 2529 (1.15), WR 2721 (1.10), WR 44923 (1.02) and WR 347 (0.94).

9095 **(DOE/ER/60119—T2) Lung cancer epidemiology in New Mexico uranium miners. Second annual report, April 1-December 15, 1984.** Samet, J.M. (New Mexico Univ., Albuquerque (USA)). Dec 1984. Contract AS04-83ER60119. 15p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003974.

For the retrospective cohort study of miners with first underground experience before 1971, abstracting and entering of the majority of the Grants Clinic smoking and mining histories has been completed, and editing is under way. All company-reported Working Level Months (WLM) data for 1967-1982 have been abstracted, keyed, and edited. For earlier years, the data base of working level measurements obtained from state agencies is also completed. Further follow-up of the cohort has been accomplished through the Social Security Administration and the National Death Index. Death certificates have been requested for 75 deceased cohort members. For feasibility evaluation of a prospective cohort study of miners with first underground experience after 1970, refinements of previous projections of available subjects have been made. An estimated 10,447 persons are available but with low mean cumlative exposures. Grants Clinic information for these miners has not yet been collected. Finally, planning for analysis has continued. To calculate comparison mortality rates, it is necessary to derive population estimates for New Mexico from 1957 through 1982. Counts have been developed for 1970 through 1982, and much of background work on the earlier years has been done. Alternative statistical approaches for data analysis are also being considered. 4 tables.

9096 **(DOE/EV/03230—T1) ^{85}Kr health effects research. Status report.** Kirk, W.P. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). 15 May 1980. Contract AI01-76EV03230. 40p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85004094.

The objective was to assess the relative hazards of exposure to ^{85}Kr. Studies included: (1) in vivo kinetics studies with rats and guinea pigs; (2) in vivo determination of solubility of ^{85}Kr in guinea pig blood and 22 tissues; (3) determination of median lethality for inhalation of ^{85}Kr by guinea pigs; (4) determination of the effects of inhalation of ^{85}Kr, LD_{50} levels, on the formed elements of guinea pig peripheral blood; (5) determination of median lethal exposure for 24 hours by immersion by guinea pigs, rats, and Chinese hamsters; (6) determination of the effects of immersion exposure to ^{85}Kr on the formed elements of guinea pig peripheral blood; (7) evaluation of the late effects of 24 hours immersion of guinea pigs and female Sprague Dawley rats; and (8) replicate leukemogenesis study on strain 2 guinea pigs. (ACR)

9097 **(DOE/EV/10095—T1) Health effects of low-level radiation in shipyard workers: report of previous work.** Matanoski, G.M. (Johns Hopkins Univ., Baltimore, MD (USA). Dept. of Epidemiology). 1984. Contract AC02-79EV10095. 230p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE85003311.

Progress over the course of the Nuclear Shipyard Workers Study is reported. The derivation of the study population, the gathering of health histories, the US Navy radiation protection program, and the determination of radiation exposures is described. (ACR)

9098 **(IAEA-TECDOC—307) Semi-dwarf cereal mutants and their use in cross-breeding II.** (Joint FAO/IAEA Div. of Isotope and Radiation Applications of Atomic Energy for Food and Agricultural Development, Vienna (Austria)). May 1984. 293p. (CONF-8208200—). NTIS (US Sales Only), PC A13/MF A01. File Number DE85780122.

From Research co-ordination meeting on evaluation of semi-dwarf cereal mutants for cross breeding; Davis, CA, USA (30 Aug 1982).

Items within the scope of EDB have been entered individually into the data base. (ACR)

9099 **Fission-spectrum neutrons at a low dose rate enhance neoplastic transformation in the linear, low dose region (0-10 cGy).** Hill, C.K.; Han, A.; Elkind, M.M. (Argonne National Lab., IL (USA)). *International Journal of Radiation Biology and Related Studies in Physics, Chemistry and Medicine;* **46**: No. 1, 11-15(Jul 1984).

The neoplastic transformation of C3H 10T1/2 cells induced by fission-spectrum neutrons delivered at a high dose rate is linear up to 40 cGy. Reducing the dose rate increases the frequency of transformation in the low dose region. At a dose rate of 0.086 cGy min^{-1}, the initial part of the induction curve remains linear but it has a slope 9-fold greater than the initial part of the curve at a high dose rate.

9100 **Liposomal preparations of calcium- or zinc-DTPA have a high efficacy for removing colloidal ytterbium-169 from rat tissues.** Blank, M.L.; Byrd, B.L.; Cress, E.A.; Washburn, L.C.; Snyder, F. (Oak Ridge Associated Universities, Inc., TN (USA). Medical and Health Science Div.). *Toxicology;* **30**: No. 4, 275-281(Apr 1984).

Results from this study demonstrate that liposomes increase the effectiveness of chelating agents in removing heavy metals from contaminated tissues in vivo. We compared the ability of free and liposomal preparations of Ca- and Zn-diethylenetriaminepentaacetic acid (DTPA) to remove ^{169}Yb from tissues of rats previously injected intravenously with either soluble or colloidal forms of ^{169}Yb. Although single injections of liposomal Zn-DTPA were better than the free chelator in reducing the body burden of ^{169}Yb administered in a soluble form (citrate), the liposomal preparations of Zn-DTPA or Ca-DTPA were even more effective in removing the ^{169}Yb that had been injected as the colloidal form. However, a second injection of liposomal Zn-DTPA given 8 days after the initial treatment was not as effective in removing ^{169}Yb as a second injection of the free chelator. Whether injected in the free or liposomal forms, Ca-DTPA was more effective than Zn-DPTA in removing the colloidal ^{169}Yb. Significantly lower amounts of colloidal ^{169}Yb remained in the liver, kidney, muscle, bone, and blood of rats after injection of the liposomal preparations of Ca- or Zn-DTPA than in corresponding organs of the controls ($P<0.01$). The

liposomal preparations were also more efficient in reducing the retention of colloidal ^{169}Yb in bone and blood than the free chelators ($P<0.01$). 13 refs.

5602 Thermal Effects

9101 **Effect of salinity and temperature on the post-larval growth of the crab Rhithropanopeus harrisii.** Hartnoll, R.G. (Duke Univ. Marine Lab., Beaufort, NC). pp 349-358 of Physiology and behaviour of marine organisms. McLusky, D.S.; Berry, A.J. (eds.). Oxford, England; Pergamon Press (1978). (CONF-7709240—). Contract AS05-76EV14377.

From 12. European symposium on marine biology; Stirling, UK (1 Sep 1977).

Growth from the first to the sixth post-larval instars was followed in nine salinity-temperature combinations. About 40 isolated crabs were maintained in each regime and survival, moult increment and intermoult duration monitored. Significant mortality was limited to the lowest (20°C) temperature series, where it increased for 2% at 7.5‰ to 55% at 32.5‰. Intermoult duration was affected little by salinity, but increased at lower temperatures. Moult increment decreased with size, increased with temperature, and varied with salinity in the order $20 > 32.5 > 7.5$‰. The mean size of the sixth instar ranged from 3.5 mm (20°C, 7.5‰) to 5.0 mm (30°C, 20‰). Relationships are derived between carapace width on one hand, and intermoult period, moult increment and coefficient of variation of instar size on the other. These are used to generate growth curves and population models.

5603 Chemicals Metabolism And Toxicity

REFER ALSO TO CITATION(S) 5603008192, 8790, 9044, 9045, 9051, 9115

9102 **(CONF-841251—1) Utilization of mammalian cells in vitro and in vivo for testing the genotoxic effects of environmental waste.** Hsie, A.W.; Schenley, R.L.; Perdue, S.W. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004431.

From EPA quality based toxics reduction program meeting; Cincinnati, OH, USA (3 Dec 1984).

Various modulating effects have been observed on the mutagenicity of model mutagens using the exogenous metabolic system (S9) which was used to transform promutagens to ultimate mutagens in CHO cells. 24 references.

9103 **(PB—84-246230) Relationship between the metabolism of haloacetonitriles and chloroform and their carcinogenic activity.** Pereira, M.A.; Daniel, F.B.; Lin, E.L.C. (Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab.). Sep 1984. 19p. (EPA/600—D-84/203). NTIS, PC A02/MF A01.

Halogenated acetonitriles, found in chlorinated drinking water, are formed by the reaction of chlorine with algae, fulvic acid, and proteinaceous material in the source water. The metabolism of halogenated acetonitriles was investigated in relation to their possible carcinogenic activity. Chloroacetonitrile (CAN), dibromoacetonitrile (DBAN), dichloroacetonitrile (DCAN), bromochloroacetonitrile (BCAN), and trichloroacetonitrile (TCAN) were shown to bind the nucleophilic trapping agent, p-nitrobenzylpyridine, without metabolic activation and to produce strand breaks in the DNA of cultured human CCRF-CEM cells. In addition, DCAN bound DNA in vitro without metabolic activation producing an adduct to adenine, and DBAN bound rat-liver DNA following oral administration.

9104 **(PB—85-104107/XAD) Filter extraction and Ames bioassay results for EPA (Environmental Protection Agency) particulate samples. Final report September 1983-May 1984.** Warner-Selph, M.A. (Southwest Research Inst., San Antonio, TX (USA)). Aug 1984. 31p. NTIS, PC A03/MF A01.

This report describes filter extractions and Ames bioassay of filter extracts performed for the Emission Control Technology Division of Environmental Protection Agency. Eight sets of particulate-loaded filters were provided to SwRI by the sponsor. The filters were soxhlet-extracted in methylene chloride, and the extracts were dried and weighed. The organic extracts were analyzed using the Ames bioassay at Southwest Foundation for Biomedical Research (SFBR), formerly Southwest Foundation for Research and Education. The data were analyzed using linear and non-linear regression methods.

9105 **Metabolism of 1-[14C]nitropyrene in isolated perfused rat livers.** Bond, J.A.; Medinsky, M.A.; Dutcher, J.S. (Inhalation Toxicology Research Inst., Albuquerque, NM). *Toxicology and Applied Pharmacology;* **75**: No. 3, 531-538(30 Sep 1984).

1-Nitropyrene (1-NP), a constituent of diesel exhaust, is carcinogenic to rats and is a bacterial and mammalian mutagen. Biliary and fecal excretion of 1-NP metabolites are the major routes of excretion in rats, suggesting that hepatic metabolism plays a dominant role in determining the biological fate of 1-NP. The purpose of this investigation was to quantitate 1-[14C]NP metabolites formed in isolated perfused rat livers and excreted in bile from rats. Perfused rat livers displayed a capacity for oxidation, reduction, acetylation, and conjugation of 1-NP (or its metabolites). Reduction of 1-NP followed by N-acetylation was the major metabolic pathway observed in the perfused livers. Acetylaminopyrene (AAP) was the major metabolite detected, with total quantities (150 nmol) accounting for about 60% of the total 1-[14C]NP dose (258 nmol) added to the perfusate. Considerably smaller quantities of aminopyrene and hydroxynitropyrenes were also detected. Livers perfused with 1-[14C]NP excreted about 36 nmol equivalents of 1-[14C]NP (12% of the total 1-NP dose) in bile after 60 min. Some of the biliary metabolites were tentatively identified as metabolites of the mercapturic acid pathway. The spectrum of biliary metabolites was qualitatively identical to that seen in bile from intact rats. Quantities of 14C covalently bound to hepatic macromolecules from perfused livers were 0.4 nmol 1-NP eq/g liver. The data from this study indicate that the liver may be an important site for metabolism of 1-NP.

9106 **In vitro approach to studying cutaneous metabolism and disposition of topically applied xenobiotics.** Kao, J.; Hall, J.; Shugart, L.R.; Holland, J.M. (Oak Ridge National Lab., TN). *Toxicology and Applied Pharmacology;* **75**: No. 2, 289-298(15 Sep 1984).

The extent to which cutaneous metabolism may be involved in the penetration and fate of topically applied xenobiotics was examined by metabolically viable and structurally intact mouse skin in organ culture. Evidence that skin penetration of certain chemicals is coupled to cutaneous metabolism was based upon observations utilizing [14C]benzo[a]pyrene (BP). As judged by the recovery of radioactivity in the culture medium 24 hr after in vitro topical application of [14C]BP to the skin from both control and 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD)-induced C3H mice, skin penetration of BP was higher in the induced tissue. All classes of metabolites of BP were found in the culture medium; water-soluble metabolites predominated and negligible amounts of unmetabolized BP were found. As shown by enzymatic hydrolysis of the medium, TCDD induction resulted in shifting the cutaneous metabolism of BP toward the synthesis of more water-soluble conjugates. Differences in the degree of covalent binding of BP, via diol epoxide intermediates to epidermal DNA, from control and induced tissues were observed. These differences may reflect a change in the pathways of metabolism as a consequence of TCDD induction. These results indicated that topically applied BP is metabolized by the skin during its passage through the skin; and the degree of percutaneous penetration and disposition of BP was dependent upon the metabolic status of the tissue. This suggests that cutaneous metabolism may play an important role in the translocation and subsequent physiological disposition of topically applied BP.

5604 Other Environmental Pollutant Effects

9107 **(AD-A—145946/0/XAD) Genetic effects of microwave exposure on mammalian cells in vitro. Volume 1. Annual report February 1980-June 1981.** Meltz, M.L.; Walker, K.A. (Texas Univ., San Antonio (USA). Health Science Center). Jun 1984. 38p. NTIS, PC A03/MF A01.

The effects of radiofrequency radiation (RFR) on the DNA repair process in MRC-5 normal human fibroblast cells grown in vitro have been investigated. The power levels chosen, 1 and 10 mW/sq cm, did not result in measurable temperature above the 37 C incubation temperature at either 350 MHz or 1.2 GHz (continuous or pulse-wave modes). DNA repair was induced by exposure of the cells to ultraviolet light (UV). Repair synthesis was measured by means of a repair replication protocol; i.e., a repair labeling incubation with 3H-thymidine and nonradioactive 5-bromodeoxyuridine (or 3H-BrUdR in early experiments), followed by DNA isolation and two sequential alkali cesium chloride-cesium sulfate density gradient centrifugations. In summary, 1.2-GHz continuous wave (CW) and 350 pulse-wave and continuous-wave RFR, at power levels of 1 and 10 mW/sq cm, did not appear to perturb UV light-induced DNA repair synthesis. A possible stimulation by 350-MHz CW radiation of repair label incorporation during the first hour after UV exposure, at 1 mW/sq cm (but not at 10 mW/sq cm), remains to be confirmed. No evidence exists of RFR induction, by itself, of DNA damage and repair at 1.2 GHz and 350-MHz (CW) at a power level of 10 mW/sq cm.

9108 **(AD-P—004044/4/XAD) Evaluation and control of laser hazards.** Holtrup, G. (Bundesministerium der Verteidigung, Bonn (Germany, F.R.)). May 1984. 4p. NTIS, PC A02/MF A01.

This article is from 'Occupational Medicine Relevant to Aviation Medicine, Conference Proceedings of the Aerospace Medical Panel Symposium Held at London on 4 October 1983', AD-A146 458, p. 7-1-7-4.

Powerful lasers are used in modern weapon systems for the purpose of range finding, target illumination or designation and weapon guidance. As laser radiation can be harmful to human health, control of field and airborne lasers becomes necessary. This control must rely on the determination of the hazardous zones associated with the laser's operation. The safety guidelines for field and airborne lasers should centre on limiting the access of personnel to laser areas, limiting laser operation in occupied areas and limiting the exposure of personnel to laser radiation. Protection standards have been worked out which enable to classify a laser system and establish an adequate hazardous zone. A summary of international agreements on laser safety is given and a survey of the LASER SAFETY REGULATIONS valid for the German forces is presented. Examples are given for the most commonly used rangefinder of the German Army. Problems arising from airborne laser operations are discussed. Future development of eye-safe lasers is outlined.

9109 **(NP—5770053) Study for the registration of biological effects of 50 Hz magnetic fields.** Sander, R. (Hannover Univ. (Germany, F.R.). Fakultaet fuer Maschinenwesen). 23 Jun 1982. 234p. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number TI85770053.

In order to enable precise statements on the influence of strong 50 Hz magnetic fields on living beings, and their effects on human organisms in particular, the most suitable examination concept is one allowing comparative observations under predefined laboratory conditions. The paper at hand describes such an experimental set-up, including the required field-generating devices as well as test methods adapted to the specific field requirements. Suitable examination methods are presented, and the results obtained from observations are discussed.

57 HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 5700008331, 9050

9110 **(PB—84-238211) Development of performance criteria for protective clothing used against carcinogenic liquids. An interim report relating to benzene.** Coletta, G.C.; Schwope, A.D.; Todd, W.F. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Nov 1977. 25p. NTIS, PC A02/MF A01.

See also PB-299318.

A test method was devised to evaluate protective clothing resistance to permeation of carcinogens, including benzene (71432), under continuous contact. A liquid permeation test cell was assembled containing a membrane that divided the cell into two chambers that exposed the material specimen to a carcinogenic liquid on one surface and a perspiration simulant on the other. Samples of perspiration simulant were withdrawn continuously or at intervals and analyzed for carcinogen. A steady state permeation rate was established by the linear increase in carcinogen concentration as a function of time. Twenty samples of protective clothing materials were evaluated for resistance to benzene. Neoprene (69028371) was the only material currently recommended for benzene use that prevented breakthrough for more than 10 minutes. Butyl-rubber (9010859) prevented breakthrough for more than 1 hour, and viton (58899) delayed breakthrough for more than 8 hours. The authors conclude that many workers are not adequately protected. Protection could be improved if comprehensive permeation data is used in the evaluation and selection of materials.

9111 **(PB—84-239102) Sampling design for the OHSMI (Occupational Hazard Survey of the Mining Industry). Volume 2. Final report.** Katt, R.; Elias, G.; Moore, E. (JRB Associates, Inc., McLean, VA (USA)). Nov 1982. 429p. NTIS, PC A19/MF A01.

See also PB83-253070.

Procedures used to develop the sampling design for the Occupational Hazard Survey of the Mining Industry are illustrated. Sample frames outline the active metal mines stratified by commodity and community for iron (7439896) ore, copper (7440508) ore, lead (7439921) and zinc (7440666) ores, silver (7440224) ore, aluminum (7429905) ore, cobalt (7440484), manganese (7439965), molybdenum (7439987), nickel (7440020), uranium (7440611), vanadium (7440622), clays, barite (13462867), phosphate (14265442) rock, gypsum (13397245), asbestos (1332214), mica (12001262), and vermiculite (1318009). Manually selected self representing units are listed by standard industrial classification, mine identification number, and by geographic location. A sample draw is presented for an occupational hazard survey of the mining industry that shows the name of the mine and types of employment at the particular facility, subunit types, other operations on the same property, and numbers of employees, as well as location and union memberships. The projection algorithm subroutine code for the estimation of population totals and variances is exhibited. Representative data for stratum 1 and stratum 2 population and sample data, with projected totals for cells 1 and 2, are shown.

9112 **(PB—84-239573) Survey report, Safety Clothing and Equipment Division, Safety First Industries, Inc., Cleveland, Ohio.** Froehlich, P.A. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 30 Mar 1972. 9p. (HHE—72-004). NTIS, PC A02/MF A01.

A survey was conducted to determine possible environmental asbestos (1332214) contamination at the Safety Clothing and Equipment Division (SIC-3842) of Safety First Industries, Incorporated, in Cleveland, Ohio, on March 30, 1972. The study was requested by the executive vice president of the company. Atmospheric samples for dust were taken in employee breathing zones during dust producing operations. A total of 11 operations were sampled; only 1 did not meet the standard of five fibers greater than 5 microns in length per milliliter for an 8 hour time weighted exposure. The author recommends that a properly designed hood be installed to enclose the glove and mitten turning operations, and employees should be instructed that wet brushed fabric may be as hazardous to health as other methods, even though there is less visible dust.

9113 **(PB—84-241736) Control technology for Richard Klinger, Inc., Sidney, Ohio. Indepth survey report.** Heitbrink, W.A. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 25 Jun 1984. 39p. (CT—144-15B). NTIS, PC A03/MF A01.

Environmental and breathing zone samples were analyzed for asbestos (1332214) at Richard Klinger Incorporated (SIC-3069), Sidney, Ohio in August 1983 as part of an in depth study of dust control during bag opening, dumping, and disposal. Asbestos control technology was inspected. Control of asbestos at the facility was achieved by using an automatic cleaner to clean spills and routinely remove settled and spilled asbestos from the floor. During periods of peak exposure, workers wore NIOSH approved respira-

tors and disposable coveralls. Air sampling was used to identify any asbestos control problems. Closed bales of asbestos were torn. The author concludes that operation of the bag slitter does not increase asbestos concentrations. Closed bales of asbestos may be an emission source. Improving the quality of the wrapping around the bales and handling techniques during shipment are recommended.

9114 **(PB—84-241959) Control technology assessment of hazardous waste disposal operations in chemicals manufacturing: at 3M Company Chemolite incinerator, Cottage Grove, Minnesota, indepth survey report.** Anastas, M. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jan 1984. 50p. (CT—103-11B). NTIS, PC A03/MF A01.

Environmental and breathing zone samples were analyzed for organic solvents and total hydrocarbons at the Chemolite incinerator at 3M Company (SIC-2800), Cottage Grove, Minnesota in September 1982. Engineering controls in the pump room and on the drum feed system were investigated. Concentrations of all solvents and total hydrocarbons were below all relevant standards or the limits of detection. General and local exhaust ventilation were used to suppress air contaminant concentrations in the pump room. The ventilation system supplied fresh air at the rate of 15 room changes per hour. General dilution ventilation was the primary control on the drum feed system. A carbon-dioxide injection system and overhead vent were used to minimize potential fire and explosion hazards. Grounding devices were installed on liquid waste feed lines to prevent the occurrence of sparks caused by flowing liquids. Hard hats, safety glasses, company provided uniforms, and safety shoes were routinely worn at the incineration site. Rubber suits, face shields, and half face respirators were worn when corrosive materials were handled. The company had intensive training and education programs. Only minor injuries occurred during the 11 year history of the facility.

9115 **(PB—85-102937/XAD) Health hazard evaluation report HETA 81-174-1328, Aluminum Company of America, Newburgh, Indiana.** Ahrenholz, S.H.; Schulte, P.A. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jun 1983. 11p. NTIS, PC A02/MF A01.

To evaluate worker mortality due to leukemia and diseases of the blood-forming organs associated with coal tar pitch volatile exposures, proportionate mortality ratios (PMR) were computed for most major causes of death by comparing observed to expected deaths. Three causes of death had a statistically significant excess number of deaths. These were: cancer of the rectum, PMR = 459 (2 observed, 0.44 expected); all cancers of the liver, PMR = 8.27 (2 observed, 0.24 expected); and neoplasms of lymphatic and hematopoietic tissue other than lymphosarcoma, Hodgkin's disease, and leukemia, PMR = 388 (2 observed, 0.52 expected). To further evaluate these findings, proportionate cancer mortality ratios (PCMR) were computed. Only cancer of the liver remained statistically in excess.

9116 **(PB—85-102952/XAD) Health hazard evaluation report HETA 81-416-1334, Trailways Bus System, Denver, Colorado.** Pryor, P. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jul 1983. 15p. NTIS, PC A02/MF A01.

To evaluate the exposures of baggage handlers and porters to bus diesel emissions and carbon monoxide exposures to reservationists, a total of eight area samples were taken for sulfur dioxide, nitrogen dioxide, total particulates, and formaldehyde. The higher levels were dependent on automobile peak traffic. All the levels in the reservationists room were below the 8-hour time-weighted average (TWA) for both the OSHA standard of 50 ppm and the NIOSH TWA criterion of 35 ppm. A potential health hazard existed in the reservation office based on high CO levels detected at the building's air make-up source and correspondingly high CO levels in the reservationists room.

9117 **(PB—85-102960/XAD) Health hazard evaluation report HETA 82-224-1336, Miami Fire Department, Miami, Florida.** Salisbury, S. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jul 1983. 19p. NTIS, PC A02/MF A01.

To evaluate the possibility that fire fighters had been exposed to polychlorinated biphenyls (PCBs) during an electrical fire inside an underground transformer vault, samples were collected 3 days after the fire, and subsequent to cleanup of the vault by the power company. The results support the findings of other studies which indicate that polychlorinated dibenzofurans are trace contaminants of technical grade PCB oils and may be produced during fires involving PCBs.

58 GEOSCIENCES

5801 Geology And Hydrology

REFER ALSO TO CITATION(S) 5801008196, 8197, 8263, 8311, 8312, 8314, 8315, 8316, 8407, 8465

9118 (DOE/METC—84-9, pp 3-6) **Lineaments: a look forward and backward.** Lattman, L.L. (New Mexico Inst. of Mining and Tech., Socorro). Apr 1984. NTIS, PC A04/MF A01. File Number DE84009291.

In Workshop on remote sensing/lineament applications for energy extraction.

The author presents a brief history and some general statements about linear application, past and future. He points out that we are passing to carefully documented case histories and these carefully documented case histories are the raw data on which hypothesis will be eventually built. It is his conclusion after 30 years that we know something about how to use lineaments and we know something of what they do.

9119 **(RHO-BW-ST—49-P) Techniques for monitoring Eh-pH conditions in hydrothermal experiments.** Myers, J.; Ulmer, G.C.; Grandstaff, D.E.; Brozdowski, R.; Danielson, M.J.; Koski, O.H. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Mar 1983. Contract AC06-77RL01030. 43p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85005112.

In the design of a high-level nuclear waste repository it is essential to obtain accurate groundwater Eh-pH data. Design considerations such as the choice of matrix for the waste form, type and dimensions of canister material, use of buffers, and type and amount of backfill would all benefit from an exact knowledge of oxidation potentials (Eh) and acidity levels (pH) of the groundwater. For the radionuclides themselves, it cannot be overstated that the future containment, dissolution, migration, sorption, and precipitation of radionuclides will be determined by the Eh-pH conditions existing in the repository environment. The Basalt Waste Isolation Project has initiated a research effort to develop sensors that can be mounted in autoclaves to provide constant monitoring of the Eh-pH conditions that exist during waste form/barrier material/groundwater hydrothermal interaction tests. Sensors must withstand temperatures up to 300°C and pressures up to 300 bars. This report considers platinum group metallic hydrogen diffusion membranes, hydride electrodes and resistance probes, Teflon hydrogen diffusion membranes, and zirconia pH sensors. Of these four techniques, zirconia pH sensors and Teflon hydrogen diffusion membranes show the most promise for use as sensors at elevated temperatures and pressures. The development of these sensors represents a significant advance in the monitoring of Eh and pH conditions at elevated temperatures and pressures. 28 references, 6 figures, 4 tables.

5802 Geophysics

9120 **(LA-UR—84-3762) 3-D treatment of convective flow in the earth's mantle.** Baumgardner, J.R. (Los Alamos National Lab., NM (USA)). May 1984. Contract W-7405-ENG-36. 21p. (CONF-8405240—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003734.

From Transport and propagation in nonlinear systems; Los Alamos, NM, USA (21 May 1984).

A three-dimensional finite-element method is used to investigate thermal convection in the earth's mantle. The equations of motion are solved implicitly by means of a fast multigrid technique.

The computational mesh for the spherical problem is derived from the regular icosahedron. The calculation described use a mesh with 43,554 nodes and 81,920 elements and were run on a Cray X. The earth's mantle is modeled as a thick spherical shell with isothermal, free-slip boundaries. The infinite Prandtl number problem is formulated in terms of pressure, density, absolute temperature, and velocity and assumes an isotropic Newtonian rheology. Solutions are obtained for Rayleigh numbers up to approximately 10^6 for a variety of modes of heating. Cases initialized with a temperature distribution with warmer temperatures beneath spreading ridges and cooler temperatures beneath present subduction zones yield whole-mantle convection solutions with surface velocities that correlate well with currently observed plate velocities. 8 references, 6 figures.

5803 Mineralogy, Petrology, And Rock Mechanics

REFER ALSO TO CITATION(S) 5803008334, 8408, 8413

9121 **(DOE/ER/13228—1) Mechanical properties of rocks at high temperature and pressures. Progress report Number 1, 1 March-15 November 1984.** Friedman, M.; Handin, J.; Bauer, S.J.; Choi, Y.J.; Hopkins, T.W.; Shimamoto, T. (Texas A and M Univ., College Station (USA). Research Foundation). Nov 1984. Contract FG05-84ER13228. 71p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85004467.

Studies of borehole stability and the fracture of rock in environments of hot fluids and differential stresses were continued. The tensile strength of Sioux quartzite, fracture surfaces and microfracture abundances in the extension experiments, and frictional strength variation with temperature of mineralized fractures were investigated. 50 references. (ACR)

5804 Geochemistry

9122 **Plutonium oxidation state distributions in the Pacific Ocean during 1980-1981.** Nelson, D.M. (Argonne National Lab., IL (USA). Radiological and Environmental Research Div.); Carey, A.E.; Bowen, V.T. (Woods Hole Oceanographic Institution, MA (USA)). *Earth and Planetary Science Letters;* **68**: No. 3, 422-430(Jun 1984).

The concentration of plutonium and its oxidation state distribution have been measured as a function of depth at three locations in the North Pacific Ocean. Concentration profiles were similar to those observed in the same area during 1974 with primary maxima at depths of a few hundred meters below the surface and secondary maxima near the bottom. Oxidation state distribution profiles were similar at the three locations with plutonium about equally divided between the reduced and oxidized forms except near the bottom. There the oxidized form was more abundant and comprised proportional90% of the total plutonium. No major change in oxidation state occurred at the depths of the shallow concentration maxima suggesting that their formation and persistence were not dependent upon a redox change. The concentration maxima near the bottom coincided with the enhanced abundance of the poorly sorbed oxidized form suggesting that they resulted from the loss of oxidized plutonium from the sediments.

5805 Oceanography

REFER ALSO TO CITATION(S) 5805008953

9123 **Average vertical mixing coefficient for the oceanic thermocline.** Li, Y.H.; Broecker, W.S. (Columbia Univ., Palisades, NY (USA). Lamont-Doherty Geological Observatory); Peng, T.H. (Oak Ridge National Lab., TN (USA)); Oestlund, H.G. (Miami Univ., FL (USA). Rosenstiel School of Marine and Atmospheric Sciences). *Tellus, Series B: Chemical and Physical Meteorology;* **36**: No. 3, 212-217(Jul 1984).

The new estimate of the average vertical mixing coefficient for the oceanic thermocline, based on all GEOSECS tritium data, is $1.7 +- 0.2\ cm^2 s^{-1}$.

64 PHYSICS. I.

6401 Astrophysics And Cosmology

REFER ALSO TO CITATION(S) 6401009189, 9239

9124 **(AD-A—146689/5/XAD) Waves and instabilities in collisionless shocks. Progress report.** Gurnett, D.A. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). Apr 1984. 67p. NTIS, PC A04/MF A01.

By scattering particles and causing dissipation, waves in a collisionless shock play a role similar to collisions in an ordinary gas. In describing the waves and instability that occur near a shock three regions must be considered: (1) the transition region, (2) the upstream region, and (3) the downstream region. The transition region is usually characterized by an abrupt broadband burst of electrostatic noise extending to frequencies well above the ion plasma frequency, and by a broadband burst of whistler-mode electromagnetic noise at frequencies below the electron cyclotron frequency. The burst of electrostatic noise is believed to be the primary mechanism by which heating and dissipation takes place at the shock. This noise is believed to be ion-acoustic noise driven either by a current or an electron beam in the shock. Electrostatic lower-hybrid waves are also sometimes observed in the transition region. These waves are excited by ions reflected by the shock, and can be very effective at heating both ion and electrons. This paper reviews all of the above waves and comments on the similarities between waves observed near the bow shocks of earth, Venus, Jupiter and Saturn, and interplanetary shocks. Possible mechanisms for generating each type of wave are also considered.

9125 (CONF-830642—, pp 533-574) **Rarefied, rotational gas flows in spiral galaxies.** Roberts, W.W. Jr.; Hausman, M.A. (Virginia Univ., Charlottesville). 1983. NTIS, PC A99/MF A01. File Number DE84006270.

From 5. international workshop on gases in strong rotation; Charlottesville, VA, USA (5 Jun 1983).

We develop a computational model of a rotating, rarefied gas in which the individual molecules collide inelastically and are subject to circularly asymmetric external forces and internal heating sources. This model is applied to the interstellar medium (ISM) of spiral galaxies, in which most of the matter is confined to discrete gas clouds separated by a tenuous intercloud medium. We identify inelastically-colliding gas molecules with interstellar clouds which orbit ballistically in the galactic gravitational field and are perturbed by expanding shells surrounding supernovae. When a small, spiral perturbation is added to the gravitational force to mimic a spiral galaxy, the cloud distribution responds with a strong, global shock. In the model, stars are formed from the gas when clouds collide or are perturbed by supernovae; these stars are the internal heating sources for the gas cloud system. We determine the morphologies (evolution, distribution) of the two components, gas and stars, in the model as functions of varying input physics. Variation of the cloud system's collisional mean free path (over physically-realistic ranges) has remarkably little influence on the computed shock structure.

9126 **(DOE/ER/05007—21) Particle theory and cosmology. Progress report, March 31, 1984-April 1, 1985.** Gaisser, T.K.; Steigman, G. (Delaware Univ., Newark (USA). Bartol Research Foundation). 30 Nov 1984. Contract AC02-78ER05007. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004282.

The primary emphasis of this research is to do particle physics with cosmic rays. Current examples are a study of cross sections at square root $s \sim 50$ TeV and use of cosmic ray neutrinos to calibrate nucleon decay detectors. An important dividend is the opportunity to apply particle physics results and ideas to problems of astrophysical interest. Development of relevant hadron phenomenology is a continuing part of the program. Much of this research is being done in collaboration with Dr. Todor Stanev, a research scientist at Bartol whose work is currently supported by the National Science Foundation. Apart from the neutrino calculations, our focus is on the high energy region, 10^{14} eV to 10^{19} eV (square root

s ~ 0.5 - 100 TeV). At these energies the cosmic ray flux is too low for direct observation of the primaries above the atmosphere, so one must rely on interpretation of their atmospheric cascades, which can be observed with ground-based detectors with large exposure factors. Development and application of an extensive set of computer simulations of the cascades to various experiments is therefore a major part of our work. Our goal is to understand the physical implications of these indirect experiments.

9127 **(FNAL/Pub—84/120-A) Gravitinos as the cold dark matter in an Ω = 1 universe.** Olive, K.A.; Schramm, D.N.; Srednicki, M. (Fermi National Accelerator Lab., Batavia, IL (USA)). Nov 1984. Contract AC02-76CH03000. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003953.

In attempts to simultaneously have galaxy formation with adiabatic fluctuations, dark galactic halos and a critical Ω = 1, recent models have been proposed with a heavy (cold) species which decays and a lighten (hot or warm) one which is stable. Surprisingly enough, these models are very constraining. Independent of the particle physics model, the decay width of the heavy particle must be 0(10^{-40}) GeV. Such a scale is only natural in theories involving gravity where one expects Γ - M/sub H/^{3}/M/sub p/^{2}, where M/sub H/ is the mass of the heavy particle and M/sub p/ is the planck mass. In this paper, we suggest that the heavy particle might be the gravitino which is present in all supergravity theories. This model would then require that the gravitino decay products not include photons, indicating that the lightest supersymmetric particle (LSP) must be something other than the photino. An acceptable candidate for the LSP might be the axino, the supersymmetric partner of the axion.

9128 **(FNAL/Pub—84/126-A) SU(N,1) inflation.** Ellis, J.; Enqvist, K.; Nanopoulos, D.V.; Olive, K.A.; Srednicki, M. (Fermi National Accelerator Lab., Batavia, IL (USA)). Nov 1984. Contract AC02-76CH03000. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003952.

We present a simple model for primordial inflation in the context of SU(N,1) no-scale n = 1 supergravity. Because the model at zero temperature very closely resembles global supersymmetry, minima with negative cosmological constants do not exist, and it is easy to have a long inflationary epoch while keeping density perturbations of the right magnitude and satisfying other cosmological constraints. We pay specific attention to satisfying the thermal constraint for inflation, i.e., the existence of a high temperature minimum at the origin.

9129 (IC—83/221, pp 313-330) **Phase transitions in the early universe.** Kibble, T.W.B. (Imperial Coll. of Science and Technology, London (UK). Blackett Lab.). Nov 1983. NTIS (US Sales Only), PC A24/MF A01. File Number DE85780364. (CONF-8306247—).

From 3. annual ICTP summer workshop on particle physics; Trieste, Italy (20 Jun 1983).

The calculation of phase transitions in gauge theories is taken up. Considerable attention is devoted to the effective potential V(phi). The 'new inflationary universe' hypothesis is proposed as a solution to a number of cosmological problems, viz. flatness, baryon number, horizon, smoothness, and monopole problems. The success of this hypothesis is evaluated, and remaining difficulties are set forth. This paper is presented as a series of lecture notes.

9130 (IC—83/221, pp 350-353) **Stochastic properties of relativistic cosmological models near the singularity.** Khalatnikov, I.M.; Lifshitz, E.M.; Khanin, K.M.; Shchur, L.N.; Sinai, Ya. G. (AN SSSR, Moscow. Inst. Fizicheskikh Problem). Nov 1983. NTIS (US Sales Only), PC A24/MF A01. File Number DE85780364. (CONF-8306247—).

From 3. annual ICTP summer workshop on particle physics; Trieste, Italy (20 Jun 1983).

The oscillatory character of the model as t→0 is sketched. Stochasticity in the vicinity of the singularity appears to be a most general property of cosmological models based on the classical Einstein equations. Knowledge of the source of the stochastization makes it possible to construct with considerable completeness a statistical theory of the evolution of the cosmological model in asymptotic closeness to singularity. The present work shows that the parameters of the model can be calculated exactly.

9131 **(IC—83/227) Quantum mechanics of the Robertson-Walker geometry.** Christodoulakis, T.; Zanelli, J. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1983. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700197.

The Wheeler-DeWitt equation for the Robertson-Walker geometry coupled to scalar and Fermi fields is solved. Systematic use of Dirac's method for constrained systems is made and ad-hoc assumptions about the factor ordering problem arising from the classical constraints are avoided. It is thus found that the probability density of finding the universe with a radius R vanishes as the classical singularity at R=O is approached.

9132 **(IC—83/238) Effective action functional for the inflationary cosmology.** Aurilia, A.; Denardo, G.; Legovini, F.; Spallucci, E. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1983. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700241.

The use of a three-index antisymmetric potential Asub(μνrho) provides a viable mechanism to give rise to a constant vacuum energy density of arbitrary magnitude. We use this mechanism to formulate an effective action functional which provides a natural basis for the inflationary cosmology. The de Sitter phase arises from the dynamics of the system in a self-consistent way, without introducing any "ad hoc" Higgs potential.

9133 **(LBL—18703) Cooling of neutron stars with hyperons.** Maxwell, O.V. (Lawrence Berkeley Lab., CA (USA)). Nov 1984. Contract AC03-76SF00098. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004641.

One of the greatest difficulties encountered in the study of neutron stars lies in the connection between the observed properties of the stars and their interior physics. This difficulty is two-fold: on the one hand, measurements associated with the pulsed emission from pulsars and x-ray binaries are sensitive to details of emission and accretion mechanisms and consequently, depend more upon the surface properties of neutron stars than their interior properties. On the other hand, even where a dependence upon interior conditions can be established, this dependence is often masked by other considerations and typically involves just the overall M vs. R relation, which is not particularly sensitive to the detailed composition of the star. In contrast with pulsed emission phenomena, the possibility of detecting unpulsed blackbody x-rays from neutron star surfaces provides a more direct and fairly sensitive probe of interior conditions. Detection of such radiation allows one to establish a surface temperature for the star (assuming a particular value for the radius), which through solutions of the general relativistic heat transport equations in the crust, provides an estimate of the interior temperature. Because young neutron stars cool primarily by means of neutrino emission from the interior, the latter quantity is rather sensitive to the interior equation of state.

9134 **(UCRL—91788) Shell-model Lanczos-method studies of the Gamow-Teller strength function in astrophysics.** Mathews, G.J.; Bloom, S.D.; Takahashi, K.; Fuller, G.M.; Hausman, R.F. Jr. (Lawrence Livermore National Lab., CA (USA); California Univ., Santa Cruz (USA); Los Alamos National Lab., NM (USA)). Nov 1984. Contract W-7405-ENG-48. 13p. (CONF-8410144—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004205.

From International symposium on nuclear shell model; Philadelphia, PA, USA (31 Oct 1984).

We utilize the Livermore system of vectorized shell-model codes to study the Gamow-Teller stength functions for a variety of nuclei whose weak-interaction properties are of interest in astrophysics. The Lanczos method is used to diagonalize a model space consisting of low-seniority excitations (including all states directly populated by the Gamow-Teller operator) with a realistic finite-range effective interaction. The effects of model-space truncation are systematically investigated for each nucleus. The results of these calculations are discussed in connection with problems in stel-

lar evolution, supernova collapse, and nucleosynthesis. 20 references, 8 figures.

9135 **Cosmic strings and galaxy formation.** Silk, J.; Vilenkin, A. (Department of Astronomy, University of California, Berkeley, California 94720). *Physical Review Letters;* **53**: No. 17, 1700-1703(22 Oct 1984). Contract AT03-82ER40069.

Accretion onto closed loops of vacuum string results in the formation of compact objects of subgalactic mass which are comparable in number to the frequency of active galactic nuclei and quasars. Such structure develops in baryon- and neutrino-dominated, as well as in axion-dominated, cosmological models. Planar wakes also develop behind relativistically moving open strings and generate fluctuations of order unity in the galaxy density on scales comparable to those of galaxy superclusters.

9136 **Is the metal contribution to the astrophysical opacity incorrect?.** Magee, N.H. Jr.; Merts, A.L.; Huebner, W.F. (T-4, Los Alamos National Laboratory). *Astrophysical Journal;* **283**: No. 1, 264-272(1 Aug 1984).

Numerical tests by Simon have indicated that an arbitrary increase in the metal (atomic number Z>2) contribution to the opacity by a factor of 2 to 3 leads to Cepheid models that, in some aspects, are in better agreement with observations than models using the standard opacity. We show that such a large increase in opacity is incompatible with atomic physics.

6402 Atmospheric Physics

9137 **(AD-A—145572/4) Propagation and growth of whistler mode waves generated by electron beams in Earth's bow shock. Progress report.** Tokar, R.L.; Gurnett, D.A. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). Apr 1984. 50p. NTIS, PC A03/MF A01.

Sponsored in part by Grant NGL-16-001-043.

In this study, the propagation and growth of whistler mode waves generated by electron beams within Earth's bow shock is investigated using a planar model for the bow shock and a model electron distribution function. Within the shock, the model electron distribution function possesses a field-aligned T > T beam that is directed toward the magnetosheath. Waves with frequencies between about 1 and 100 Hz with a wide range of wave normal angles are generated by the beam via Landau and anomalous cyclotron resonances. However, because the growth rate is small and because the wave packets traverse the shock quickly, these waves do not attain large amplitudes. Waves with frequencies between about 30 and 150 Hz with a wide range of wave normal angles are generated by the beam via the normal cyclotron resonance. The ray paths for most of these waves are directed toward the solar wind although some wave packets, due to plasma convection travel transverse to the shock normal. These wave packets grow to large amplitudes because they spend a long time in the growth region. The results suggest that whistler mode noise within the shock should increase in amplitude with increasing upstream theta sub Bn. The study provides an explanation for the origin of much of the whistler mode turbulence observed at the bow shock.

9138 **(AD-A—145751/4/XAD) Magnetospheric plasma studies using data from the dynamics high and low altitude plasma instruments. Technical report.** Barfield, J.N. (Southwest Research Inst., San Antonio, TX (USA)). 15 May 1984. 62p. (SCIENTIFIC—2). NTIS, PC A04/MF A01.

Plasma measurements made on Dynamics Explorer 1 and 2 spacecraft are providing new information on the altitude dependence of polar-cap plasma populations, their sources, and the acceleration processes they undergo. This study found that the polar-rain electron population apparently exhibits no significant altitude dependence between altitudes of a few hundred to approximately 20,000 km. This result was expected from the magnetosheath-like energy spectrum of the low-altitude polar rain. In this case of the polar wind, a significant velocity increase was theoretically predicted to occur between the two spacecraft altitudes, and this effect was confirmed by DE-1 plasma measurements. A major result of this study of the accelerated polar wind is its significant conic component, which indicates that the ions are heated perpendicularly as they emerge from the polar-cap ionosphere. The gradual decrease in polar-wind energy observed to occur from the cusp across to the nightside polar cap suggests that the perpendicular heating process, probably in cyclotron waves, is most intense near the cusp region. Significant altitude effects are also observed in the plasmas that occupy magnetic flux tubes connected to polar-cap auroral arcs (or theta auroras). At DE-2, typical low-energy (approximately 100 eV) inverted-V electron distributions are observed. At DE-1 the electron and positive-ion distribution functions are consistent with electrostatic potential drops that are at times below the typical DE-1 altitude of 15,000 to 20,000 km and at times above these altitudes.

9139 **(AD-A—145835/5/XAD) Cause of X-line formation in the near-earth plasma sheet: results of adiabatic convection of plasma-sheet-plasma. Technical report.** Erickson, G.M. (Rice Univ., Houston, TX (USA). Dept. of Space Physics and Astronomy). 24 Apr 1984. 27p. (SCIENTIFIC—1). NTIS, PC A03/MF A01.

Self-consistent, static-equilibrium solutions are presented for two-dimensional magnetospheric-magnetic-field configurations with isotropic thermal pressure. These solutions include a dipole field and are not restricted to the asymptotic theory. Adiabatic convection of plasma sheet flux tubes is modeled as a series oif static-equilibrium solutions in which flux tubes conserve their PV(gamma) as they convect, which resulted in time dependent magnetospheric configurations. Specifically, it is found that a deep minimum in the equatorial B sub z develops in the inner plasma sheet, thereby causing the magnetic-field configuration to become more stretched and tail-like in time. These results suggest X-line formation in the inner plasma sheet as a consequence of lossless, adiabatic convection of plasma sheet flux tubes.

9140 **(LBL—18744) Simultaneous measurements of atmospheric emissions at 10, 33 and 90 GHz.** Costales, J.B. (Lawrence Berkeley Lab., CA (USA)). Nov 1984. Contract AC03-76SF00098. 47p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85005110.

Thesis.

As part of a larger experiment to measure the cosmic microwave background radiation spectrum, frequent simultaneous measurements of the microwave thermal emission from the earth's atmosphere were made at three fixed frequencies, namely, 10 GHz, 33 GHz and 90 GHz. We performed these measurements at two separate locations, Berkeley and White Mountain, which greatly differed in altitude and climatic conditions. Typical values measured in Berkeley of the atmospheric antenna temperature during good weather are 3.13 +- 0.30°K, 12.3 +- 0.3°K and 34.6 +- 0.5°K, for 10, 33, and 90 GHz respectively. Corresponding values measured at White Mountain are 1.15 +- 0.1°K, 4.51 +- 0.18°K and 11.0 +- 0.2°K. Because the measurements are simultaneous in nature, correlations between the measurements taken at the various frequencies provide constraints on models of the microwave emission of the earth's atmosphere, especially models describing atmospheric emission as a function of precipitable water content.

9141 **Modeling dynamic behavior of Radon-222 in the planetary boundary layer.** Yuan, Y.C.; Stunder, M.J. (Argonne National Lab., IL). pp 229-232 of Preprint volume of extended abstracts: sixth symposium on turbulence and diffusion. Boston, MA, USA; American Meteorological Society (1983). (CONF-830307—).

From 6. American Meteorological Society symposium on turbulence and diffusion; Boston, MA, USA (22 Mar 1983).

A model has been used to simulate the dynamic behavior of radon concentration in the lower atmosphere from naturally occurring sources. The model includes prediction of radon exhalation rate from the surface of the ground due to convection and diffusion processes and the radon concentration profile in the planetary boundary layer. A time-dependent radon exhalation rate, variable mixing height, and altitude-dependent diffusivity are incorporated into the diffusion model by transforming the governing equation. The Galerkin finite-element technique and Crank-Nicholson finite different time marching are used in solving the discretized differential equations. The model-simulated time-varying radon concentrations near the ground agree well with measurements made over a period of seven days. It has been demonstrated that the model pro-

vides a reasonably good prediction of ambient radon concentration. As a general tool, with the input of actual radon concentration measurements, the model is also capable of estimating average radon exhalation rate from the ground surface. With current techniques, radon flux measurement is still a time-consuming and difficult task.

6403 Atomic, Molecular, And Chemical Physics

REFER ALSO TO CITATION(S) 6403008868, 8876, 9271, 9396, 9400, 9401

9142 (CTA-IEAV-NT—016/83) Electric dipole moment of diatomic molecules. Comparison between the VCM and CNDO/2 methods. Rosato, A. (Centro Tecnico Aeroespacial, Sao Jose dos Campos (Brazil). Inst. de Estudos Avancados). Jan 1983. 32p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. File Number DE85700205.

The calculation of the electric dipole moment of diatomic molecules by the Variational Cellular Method is presented, discussed and compared with the semiempirical CNDO/2 method. The molecule HF is taken as example. It is also shown that the value of the electric dipole moment by the VCM improves considerably when the electronegativity of the atoms of the molecule is taken into account.

9143 (DOE/ER/10513—T3) Theoretical study of near-threshold electron-molecule scattering. Progress report. Morrison, M.A. (Oklahoma Univ., Norman (USA). Dept. of Physics and Astronomy). Jul 1984. Contract AS05-79ER10513. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004530.

Theoretical calculation of accurate low-energy electron-molecule cross sections requires: (1) an accurate interaction potential; and (2) a computationally-tractable formulation of the collision theory. The potential must be free of parameters that require adjustment to experimental cross sections. Moreover, near the threshold for a nuclear excitation the collision theory must accurately - if approximately - take account of the coupling of the nuclear dynamics and the (quantal) motion of the scattering electron. Progress has been made on two facets of the electron-molecule interaction: exchange and polarization effects. Our tuned free-electron-gas exchange potential has been generalized to allow for vibrational excitation, and, more interestingly, the validity of this model for nuclear excitations has been studied. A procedure for determining an ab initio (parameter-free) polarization potential that takes (approximate) account of non-adiabatic effects has been implemented and tested for e-H_2 scattering. Results calculated with this model potential agree well with those of benchmark optical-potential studies.

9144 (DOE/ER/10631—5) Measurements of ionization balance parameters in atomic ions. Progress report, 1 May 1982-31 October 1984. Kohl, J.L. (Smithsonian Astrophysical Observatory, Cambridge, MA (USA)). Nov 1984. Contract AC02-80ER10631. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003695.

An experiment has been developed to measure dielectronic recombination (DR) in multiply and singly charged ions. Initial photon-ion coincidence results from this laboratory suggest that for DR in C^{3+} the energy averaged cross sections in a mixing of about 1.1 V/cm is apparently smaller than that measured in larger mixing fields at the Oak Ridge National Laboratory (ORNL). This result is qualitatively consistent with theoretical predictions of field enhanced DR brought about by the decrease in the autoionization probability of high Rydberg states with increasingly larger l quantum numbers. Comparison of results from the two experiments is complicated by differences in electron energy distributions and because our experiment measures only the DR process which involves stabilization via radiative 2s-2p core relaxation while the ORNL experiment might conceivably include other recombination channels (e.g. radiative recombination). Although our present results only provide evidence for an upper limit on the C^{3+} cross section, additional data accumulation with the present experimental conditions is expected to yield actual values for DR cross sections at several energies near the 2s-2p threshold. During the present contract year, we are adding the capability to apply up to 5 V/cm mixing in order to test, directly, for field enhancement of DR.

9145 (IC—83/77) Born series for electron hydrogen molecule scattering. Khare, S.P. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1983. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700213.

It is shown that one single relationship exists between the corresponding Born terms for the elastic and inelastic scatterings of electrons, including exchange, by hydrogen molecule and helium like atom. Such a relationship is not valid for hydrogenic atom, the separated atom limit of the hydrogen molecule.

9146 (IC—83/148) New exact path integral treatment of the hydrogen atom. Pak, N.K.; Sokmen, I. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1983. 7p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700206.

Using a recently developed general new-time transformation method, free of operator ordering ambiguities by construction we reconsider the hydrogen atom problem. We solve the problem direcly without any dimension raising trick.

9147 (IC—83/172) Projected interaction picture of field operators and memory superoperators. A master equation for the single-particle Green's function in a Liouville space. Grinberg, H. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1983. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700189.

The projection operator method of Zwanzig and Feshbach is used to construct the time-dependent field operators in the interaction picture. The formula developed to describe the time dependence involves time-ordered cosine and sine projected evolution (memory) superoperators, from which a master equation for the interaction-picture single-particle Green's function in a Liouville space is derived.

9148 (IC—83/176) Variable scaling method and Stark effect in hydrogen atom. Choudhury, R.K.R.; Ghosh, B. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1983. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700208.

By relating the Stark effect problem in hydrogen-like atoms to that of the spherical anharmonic oscillator we have found simple formulas for energy eigenvalues for the Stark effect. Matrix elements have been calculated using 0(2,1) algebra technique after Armstrong and then the variable scaling method has been used to find optimal solutions. Our numerical results are compared with those of Hioe and Yoo and also with the results obtained by Lanczos.

9149 (IC—83/215) Basic extended X-ray absorption fine structure formula with spin correlations. Agarwal, B.K.; Singh, N. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1983. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700209.

The basic EXAFS formula is rederived by including the effect of spin of the photoelectron emitted in the X-ray absorption process.

9150 (IC—83/234) Random model of two-level atoms interacting with electromagnetic field. Kireev, A.N.; Kurbatov, A.M.; Meleshko, A.N. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1983. 4p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700210.

A phase transition has been studied in a random system of two-level atoms interacting with an electromagnetic field. It is shown that superradiation can arise when there is short-range order in a spin-subsystem. The existence of long-range order is irrelevant for this phase transition.

9151 (IC—83/235) Dynamics of the Dicke model and superradiant state. Bogolubov, N.N. Jr.; Kurbatov, A.M.; Kazaryan, A.R.; Neskoromnyi, V.N. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1983. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700211.

A system of two-level atoms interacting with a photon field in the "rotating wave" approximation is investigated. For the Green's function of such a system an exact equation in which the variables of the photon field are eliminated is obtained. The self-consistent field approximation and the small value of the coupling constant are used to obtain a closed system of equations. The non-equilibrium superradiant conditions are derived. The influence of the initial conditions on the system's dynamics is studied. It is shown that if the temperature of photon heat bath is not equal to zero, the only way to superradiance is spatially inhomogeneous initial conditions.

9152 (INIS-mf—9078, pp 243-255) **Ground state energy of helium-like systems.** Van der Merwe, P.duT. (Nuclear Development Corp. of South Africa (Pty.) Ltd., Pelindaba, Pretoria). 1984. NTIS (US Sales Only), PC A18/MF A01. File Number TI85780085. (CONF-8307139—; CONF-8207113—).

From 18. annual seminar on theoretical physics; Pretoria, South Africa (11 Jul 1983).

A semi-classical method, which is based on the large-N expansion, is discussed with a view to determining the ground-state energy (and excitation spectra) of two-electron systems.

9153 (INIS-mf—9078, pp 257-274) **Simple means of eliminating spurious center of mass effects.** Miller, H.G. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Research Inst. for Mathematical Sciences). 1984. NTIS (US Sales Only), PC A18/MF A01. File Number TI85780085. (CONF-8307139—; CONF-8207113—).

From 18. annual seminar on theoretical physics; Pretoria, South Africa (11 Jul 1983).

The problem of spurious excitations of the center of mass is reviewed and various remedies are discussed. A practical method for reducing center of mass effects in an L^2 discretization scheme is discussed and implemented in simple calculations involving the two lowest-lying Hartree-Fock solutions in O^{16}. Projection after variation, followed by diagonalization of the center of mass Hamiltonian in this two-state subsystem, provides a means of isolating and removing spurious excitations of the center of mass from the excitation spectrum. The use of an L^2 discretization scheme in the center of mass problem is supported by some recent numerical calculations in the three-body problem.

9154 (INIS-mf—9078, pp 233-242) **Collective particle hole excitation in a deformed ground state.** Heiss, W.D.; Lemmer, R.H. (University of the Witwatersrand, Johannesburg (South Africa)). 1984. NTIS (US Sales Only), PC A18/MF A01. File Number TI85780085. (CONF-8307139—; CONF-8207113—).

From 18. annual seminar on theoretical physics; Pretoria, South Africa (11 Jul 1983).

It is well known that the Hartree-fock ground state of an infinite system cannot support collective particle hole excitations for an attractive residual interaction. On the other hand, the break down of the random phase approximation (RPA) for attractive interactions is believed to signal the onset of a phase transition which is associated with a broken symmetry of the ground state. In the case of an infinite system, the question naturally arises as to whether a nonuniform ground state which breaks translational symmetry exists, and whether this new ground state can support collective quasi-particle quasi-hole excitations in terms of a suitably chosen single particle basis. It has been found that a self-consistent non-uniform density distribution does give rise to a lower total energy of the ground state. In the article the possibility and the properties of collective density oscillations in a non-uniform medium are investigated. From the study it appears that, while Hartree-fock and RPA are not reliable in the vicinity of the interaction strength for which the phase transition occurs, it can be reliably used beyond the interaction strength.

9155 (INIS-mf—9078, pp 275-288) **Propagation of elementary excitations and the dyson boson method.** Hahne, F.J.W. (Stellenbosch Univ. (South Africa). Dept. of Physics). 1984. NTIS (US Sales Only), PC A18/MF A01. File Number TI85780085. (CONF-8307139—; CONF-8207113—).

From 18. annual seminar on theoretical physics; Pretoria, South Africa (11 Jul 1983).

It is shown that the propagator method for elementary excitations and the Dyson-type boson mapping have a very similar structure. The particular way in which the interaction is attached to the bifermion labels, which is common in both approaches, leads to the nonhermitian boson Hamiltonian. In a new propagator description the propagation of a sole single particle is considered amidst an excited state containing several bosons. The equation for this is solved using the insight gained in the boson mapping.

9156 (INIS-SU—259, pp 231-234) **Sputtering model of thin overlayers in the MeV energy range.** Pati, F.; Mezei, G.; Koati, E.; Manuaba, A.; Lokhner, T.; Posh, L. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). 1982. NTIS (US Sales Only), PC A19/MF A01. File Number TI85780020. (CONF-8106209—Vol.4).

From 2. all-union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (23 Jun 1981).

A sputtering model of thin overlayers in the MeV range is proposed. An attempt is made to outline a qualitative description of sputtering initiated by energetic $^{14}N^{+}$ ions. As an example experimental data on sputtering of gold is given for comparison.

9157 **(JAERI-M—83-240) Atomic structure calculation of energy levels and oscillator strenghts in Fe ion, 1. 3s-3p and 3p-3d transitions in Fe XV.** Ishii, Keishi; Kubo, Hirotaka; Ozawa, Kunio. (Japan Atomic Energy Research Inst., Tokyo). Jan 1984. 32p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700212.

Energy levels and oscillator strengths were calculated for 3s-3p and 3p-3d transition arrays in Fe XV, isoelectronic to Mg I. The energy levels are obtained by the Slater-Condon theory of atomic structure, including explicitly the strong configuration interactions. The calculated wavelengths are presented for electric dipole transition with gf>= 0.0001. The calculated energy levels are given in diagrams, too. The theoretical spectra are also shown in graphical representation, where the gf is plotted as a function of the wavelength. The results are compared with experimental data, where available.

9158 **Laser probe of the atomic ionization continuum: Stimulated recombination into an excited state.** Ritchie, B. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review [Section] A: General Physics;* **30**: No. 4, 1849-1854(Oct 1984). Contract AC04-76DP00789.

A two-laser theory is formulated for the photoionization of Li atoms. The first laser is tuned above the ionization threshold of Li(2s). The second laser probes the ionized target. Stimulated recombination into Li(ns) occurs near the Raman-type resonance point $\epsilon/\mathrm{sub}\ n/s-\epsilon/\mathrm{sub}\ 2s/-\epsilon_1+\epsilon_2 = 0$ (where $n>2$ and $\epsilon/\mathrm{sub}\ q/$ is a photon energy). Near the resonance point the ionization probability is characterized by a line profile which resembles that for an autoionizing resonance.

9159 **Wavelengths and energy levels of doubly ionized uranium (UIII) obtained using a Fourier-transform spectrometer.** Palmer, B.A.; Engleman, R. Jr. (Chemistry Divison, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of the Optical Society of America B: Optical Physics;* **1**: No. 4, 609-625(Aug 1984). Contract W-7405-ENG-36.

The term analysis of complex doubly ionized spectra is made more difficult by the large number of neutral and singly ionized lines that accompany the desired spectra as well as the lack of precision in wavelengths and intensities obtained from conventional spectrographs. To overcome these difficulties, we used a Fourier-transform spectrometer to obtain the spectra of uranium in a hollow cathode filled with a helium-argon mixture or neon. The

separation of ion stages was based on the intensity variatiion of the doubly ionized lines between the two spectra. The wavelength accuracy permitted the first reported determination of energy levels in doubly ionized uranium. We report 22 low-lying odd levels and 36 high-lying even levels. The Fourier-transform spectrometer is a useful and appropriate instrument for starting the analysis of complex ionized spectra because of its wavelength and intensity accuracy.

6404 Fluid Physics

9160 **(IC—83/91) Approximation scheme for classical surface plasmas at strong coupling: Progress in the formulation of a dynamical theory.** Lu De-xin; Golden, K.I. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1983. 25p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700194.

A self-consistent approximation scheme is formulated for the calculation of the dynamical linear polarizability of classical electron monolayers. The derivation is carried out in two stages. In the first stage, the authors formulate a simple response function relation linking linear and quadratic polarizabilities; the dynamical coupling function is expressed entirely in terms of the latter. The basic elements in the derivation are the first BBGKY kinetic equation (prepared in the velocity average approximation) and the non-linear fluctuation-dissipation theorem. The new response function relation is exact at zero frequency and exactly satisfies the third frequency moment sum rule. In the second stage, self-consistency is guaranteed by approximating the quadratic polarizability in terms of linear ones. The theory is examined in the weak coupling limit where it is found that a dominant γ-independent non-RPA contribution to the damping is missing. The structure of the missing term is identified at arbitrary coupling strengths. Work is in progress to see how it can be incorporated into the approximation scheme.

9161 **(IC—83/173) New prescription to determine the two-roton parameters in liquid He II.** Sridhar, R. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1983. 6p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700246.

A new prescription is given for the evaluation of the single and two-roton parameters under the assumption that these excitations saturate the known sum rules for the dynamic structure factor.

9162 **Analysis of the stability of the compressible Ekman boundary layer.** Spall, J.R.; Wood, H.G. III. (Department of Mechanical and Aerospace Engineering, University of Virginia, Charlottesville, Virginia 22901). *Physics of Fluids;* **27**: No. 12, 2808-2813(Dec 1984).

The linear stability problem for the compressible Ekman boundary layer common to rotating fluids is formulated and the stability properties determined numerically. Three classes of unstable waves are identified (called class A, B, and C), their properties are described. The class C waves have only recently been reported in the literature and are present only in compressible Ekman boundary layers. Most of the calculations presented here are for uranium hexafluoride gas; however, critical Reynolds numbers are also computed for air and ammonia gas. Compressibility is generally found to decrease the critical Reynolds number for each class of wave. A comparison of results for the three different gases shows the stability to be largely unaffected by changes in the gas properties. Maximum growth rate calculations for each wave show the class A and B waves to be the dominant instabilities. OFF

9163 **Variational density-matrix theory of liquid ^{4}He at nonzero temperatures.** Campbell, C.E.; Kuerten, K.E.; Ristig, M.L.; Senger, G. (School of Physics and Astronomy, University of Minnesota, 116 Church Street S.E., Minneapolis, Minnesota 55455). *Physical Review [Section] B: Condensed Matter;* **30**: No. 7, 3728-3734(1 Oct 1984).

We employ the minimum principle for the Helmholtz free energy to develop a self-consistent variational theory of liquid ^{4}He at nonzero temperatures. Using the fact (demonstrated here) that the equilibrium density matrix of a boson system has non-negative matrix elements in coordinate representation, the trial density matrix in coordinate space is chosen to be an exponentiated sum of two-body functions. Adopting the separability assumption in conjunction with the hypernetted-chain approximation, we determine these functions optimally by a coupled set of Euler-Lagrange equations for the structure function S(k,T) and the energy ϵ(k,T) of the elementary excitations. In a phenomenological study we analyze the variation of S(k,T) and ϵ(k,T) with temperature, and discuss the relationship by employing experimental data on these functions at long wavelength and around the roton minimum.

9164 **Kelvin-Helmholtz instabilities of supersonic shear layers.** Choudhury, S.R.; Lovelace, R.V.E. (Department of Electrical Engineering, Cornell University). *Astrophysical Journal;* **283**: No. 1, 331-342(1 Aug 1984).

A study is made of the stability of finite-thickness compressible shear layers, v = zv/sub z/(x). Two different velocity profiles are investigated in detail using the analogy between the pressure perturbation, $\delta p = f(x) \exp [i(k/\text{sub } y/y + k/\text{sub } z/z - \omega t)]$, and the bound and scattering wave states of the one-dimensional Schroedinger equation. By analytical and numerical methods, fairly complete contour maps have been generated for the real and imaginary parts of the wave frequency (ω/sub r/ and ω/sub i/) as a function of the two free dimensionless parameters, the "reduced Mach number," Aequivalentk/sub z/v/sub z/m/(kc/sub s/), and the wavenumber, BequivalentkL. Here, v/sub z/(x = +- ∞) = +- v/sub z/m, (k/sub y/^{2} +k/sub z/^{2})/sup 1/2/, c/sub s/ is the adiabatic sound speed, and L is a length characterizing the thickness of the shear layer. Two distinct regimes of instability are delineated in the (A,B)-plane. In one regime there are unstable standing waves which are analogous to the well-known Kelvin- Helmholtz warping instability of a vortex sheet [where v/sub z/(x) is a step function]. In the second regime, there are unstable traveling wave modes which are absent in the case of a vortex sheet.

6450 High Energy Physics

9165 **(IC—83/221) Third annual ICTP summer workshop on particle physics, 20 June-31 July 1983. Collected lectures.** (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1983. 570p. NTIS (US Sales Only), PC A24/MF A01. File Number DE85780364.

Separate entries were made in the data base for the papers presented. (WHK)

9166 **(RAL—84-009) Proceedings of the school for young high energy physicists, Rutherford Appleton Laboratory, September 11-24, 1983.** Cashmore, R.D. (ed.). (Rutherford Appleton Lab., Chilton (UK)). 1984. 198p. (CONF-8309300—). NTIS (US Sales Only), PC A09/MF A01. File Number DE85780365.

From School for young high energy physicists; Chilton, UK (11 Sep 1983).

Separate entries were made in the data base for the lectures given. (WHK)

6451 Particle Interactions And Properties - Experimental

REFER ALSO TO CITATION(S) 6451009126, 9190, 9244

9167 **(CEA-N—2377) Study of the hadronic production of J/psi and T resonances from 150 to 280 GeV.** Charpentier, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Feb 1984. 231p. (In French). NTIS (US Sales Only), PC A11/MF A01. File Number DE84752347.

We have studied in a very high statistics experiment the production of the J/psi resonance by hadron beams (π^{+-}, K^{+-}, p, anti-p) of 150, 200 and 280 GeV. By comparison of the differential cross-sections dσ/dxsub(F) between our two targets (H_2 and platinum). We have shown that about 20% of the J/psi's are produced by a diffractive mechanism. The study of the 80% produced through a hard process has been done in the framework of a parton

fusion model in order to extract the gluon structure functions in both the nucleon and the pion. We have also made a comparison between different hadrons for the production cross-section as well as for the differential cross-section. Finally, the production cross-section of T by pions has been measured at our three energies. Pions are found to be about 30 times more efficient than protons in producing T's.

9168 **(CEA-N—2379) Search for narrow meson production in antipN interactions at 6 and 9 GeV.** Vilanova, D. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Feb 1984. 158p. (In French). NTIS (US Sales Only), PC A08/MF A01. File Number DE84752341.

The experiment described in this report was carried out with the SLAC hybrid bubble chamber. Evidence was found for a narrow peak of mass M approximately 2.02 GeV and width GAMMA < approximately 0.04 GeV, produced in the reaction antipp → (psub(f)antin)$\pi^+\pi^-\pi^-$ at 6 GeV and antipp → πsub(f)sub(+)(antipn)$\pi^+\pi^-$ at GeV, with an observed cross section of about 1 μb in both cases. The total statistical significance of these signals is better that 7 σ; the production mechanisms of this NantiN resonance which could be an isovector baryonium seem very complex. More classical resonances such as the ω(1670) detected in the reaction antipp → $\pi^+\pi^+\pi^-\pi^-\pi^0$ in its $\pi^+\pi^-\pi^0$ decay mode were otherwise analysed.

9169 **(CEA-N—2386) Measurement of the analysing power T_{20} in the backward elastic scattering d.p in the region of Δ-excitation and theoretical analysis of this reaction.** Boudard, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Mar 1984. 148p. (In French). NTIS (US Sales Only), PC A07/MF A01. File Number DE84752346.

We have measured the analysing power T_{20} in the backward elastic scattering d.p for 16 energies of the deuteron from 300 MeV to 2300 MeV. This is the region of the observed bump in the backward excitation function of the cross section. This bump is usually thought to be a signature of a $\Delta(3/2,3/2^+)$ dynamically excited in the intermediate state. We have also measured Ay and Ayy from 70° to 180° for Tsub(d) = 1200 MeV. We have compared both T_{20} and the backward cross section with a coherent sum between direct neutron exchange (ONT) and Δ excitation by intermediate exchange of π and rho mesons (TME). The overall shape of the cross section is reproduced. Unlike the earlier measurement from Argonne, there is a deep minimum in T_{20} at Tsub(d) = 600 MeV, in agreement with the predictions of direct exchange models. However, an additional structure producing a second minimum at Tsub(d) = 1400 MeV ($\sqrt{S}$ = 3240 MeV) is never reproduced by our calculations. This suggests either that refinements in the Δ treatment are needed or that a new reaction mechanism (resonance) takes place in that region.

9170 **(DESY—84-038) Search for the supersymmetric partner of the Z^0 in e^+e^- annihilation at PETRA.** Bartel, W.; Becker, L.; Bowdery, C.; Cords, D.; Felst, R.; Haidt, D.; Knies, G.; Krehbiel, H.; Meinke, R.; Naroska, B. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). May 1984. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85750088.

A search has been made for the zino Ztilde, the supersymmetric partner of the Z^0, in e^+e^- annihilation at PETRA using the JADE detector. In supersymmetric theories the zino is produced together with a photino (e^+e^- -> Ztildeytilde), by an exchange of a scalar electron e. The Ztilde decay modes investigated are $e^+e^-\gamma$tilde, $\mu^+\mu^-\gamma$tilde, qanti qγtilde and qanti qgtilde (with subsequent gluino decay gtilde -> qanti qγtilde). No evidence for these events has been observed. Limits are presented as a function of Ztilde mass, γtilde mass and anti e mass.

9171 **(DESY—84-042) Experimental study of the photon stucture function F_2 at Q^2 from 10 to 220 GeV^2.** Bartel, W.; Becker, L.; Bowdery, C.; Cords, D.; Felst, R.; Haidt, D.; Knies, G.; Krehbiel, H.; Meinke, R.; Naroska, B. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). May 1984. 39p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85750087.

We report on a measurement of the process e^+e^- -> e^+e^- + hadrons, where one of the scattered electrons was detected at large angles, with Q^2 ranging between 10 and 220 GeV^2. The results are analysed in terms of the photon structure functions F_2 and Fsub(l) in comparison with QCD predictions over a range of values of the visible scaling variable xsub(vis). QCD scale parameters are obtained by comparison with specific QCD models. The data are unfolded to take account of detector effects and the resulting structure functions F_2 are presented at 'true' values of x in comparison with QCD.

9172 **(DESY—84-048) Weak interactions PETRA results.** Martyn, H.U. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Jun 1984. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85750082.

Recent results on weak interactions from experiments at the PETRA e^+e^- storage ring are presented. They include the determination of the weak neutral couplings in the purely leptonic reactions e^+e^- -> e^+e^-, e^+e^- -> $\mu^+\mu^-$ and e^+e^- -> $\tau^+\tau^-$ and in the production of heavy charm and bottom quarks e^+e^- -> canti c and e^+e^- -> banti b. The weak charged current is tested in tau decays, where new data on semihadronic branching ratios and a new lifetime measurement is reported, and in semileptonic decays of charm and bottom quarks.

9173 **(DESY—84-054) New results on heavy flavor production from PETRA.** Pohl, M. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Jun 1984. 34p. (CONF-8403113—7). NTIS (US Sales Only), PC A03/MF A01. File Number TI85750480.

From Europhysics conference; Erice, Italy (4 Mar 1984).

I report on recent results obtained by experiments at the e^+e^- storage ring PETRA. Data collected at c.m.s. energies between 30 and 46.2 GeV are analyzed to single out e^+e^- -> canti c (banti b) tagged by the semileptonic decay of the quarks into muons. The transverse momenta of these muons with respect to the quark directions as well as the event shape allow for an efficient separation of the sample into its b and c contents and thus for a measurement of the c and b semileptonic branching ratios. The longitudinal momentum spectrum gives information about their fragmentation properties. Charm quark identification is also obtained by observing high momentum D^* mesons among its fragmentation products. Both methods allow for a measurement of the forward-backward charge asymmetry in b and c production, found to be in agreement with the usual assignment of weak isospin for these quarks and thus indicating that the b quark is a member of a doublet. The absence of flavor changing neutral current b dacays also supports the hypothesis that a top quark should exist. No indication of tanti t resonance production is however observed at PETRA up to $\sqrt{s}$ = 45.2 GeV.

9174 (DOE/ER/04699—T1, pp vp, Appendix B) **Particle-gamma coincidence measurements in ^{12}C + ^{12}C and ^{12}C + Pb collisions at 2.1 GeV/A incident energy.** Roche, G.; Carrol, J. Chang, C.C.; Hallman, T.; Kirk, P.N.; Koontz, R.; Krebs, G.; Madansky, L.; Mulera, T.; Pugh, H. (Lawrence Berkeley Lab., CA; Johns Hopkins Univ., Baltimore, MD; Univ. of California, Los Angeles; Univ. of Maryland, College Park). 1983. NTIS, PC A08/MF A01. File Number DE84005145.

In Experiments on the TASS and HISS spectrometers at the Bevalac. Annual progress report, April 1, 1983-March 31, 1984.

A particle-gamma coincidence experiment has been performed with a ^{12}C beam at 2.1 GeV/A from the Bevalac at Berkeley, California. Data were taken with C and Pb targets. The γ-ray spectra analysis shows no or little correlation with the energy and the kind of detected particles, mainly protons and deuterons. These spectra are interpreted in terms of π^0 temperature and production rate. The low numbers of π^0 per trigger suggest mostly peripheral collisions and the π^0 measured temperatures (120 MeV for Pb and 160 MeV for C targets) are in agreement with other published data. A search for a possible singly charged anomalon decay into a deuteron and a gamma has been done from the invariant mass distributions. The upper limits for such a process are found to be 2 to 25% of the deuteron production rate, for anomalon masses going from

100 to 400 MeV above the deuteron mass, and an anomalon mean lifetime up to about 10^{-9} s.

9175 (DOE/ER/04699—T1, pp vp, Appendix C) Pion and proton cross section from the 246 MeV/nucleon ^{139}La + ^{139}La reaction. Krebs, G.F.; Gilot, J.F.; Kirk, P.N.; Schroeder, L.S.; Miller, J.; Pugh, H.G.; Roche, G.; Vincente, J.; Benenson, W.; Beard, K. (Louisiana State Univ., Baton Rouge; Lawrence Berkeley Lab., CA; Universite de Clermont II - IN2P3, Clermont-Ferrand, France; Michigan State Univ., East Lansing, Gesellschaft fuer Schwerionenforschung, Darmstadt, Federal Republic of Germany). 1983. NTIS, PC A08/MF A01. File Number DE84005145.

In Experiments on the TASS and HISS spectrometers at the Bevalac. Annual progress report, April 1, 1983-March 31, 1984.

The pion production cross section for the inclusive reaction La + La → π^- was measured at an incident energy of 246 MeV/nucleon at 90° in the center of mass. To check for isotropy the pion production cross section was also measured at 50° in the C.M. The inclusive proton cross section was measured at 90° in the center of mass for the same heavy beam - target system and is reported here. We found no change in the slope of the pion cross section at 90° in the C.M. where recent theory predicts a dramatic effect up to a limit of E/sub C.M./ = 550 MeV.

9176 (DOE/ER/40039—9) Annual progress report and renewal request for high energy physics at Texas A and M University, January 1-December 31, 1984. Webb, R.C. (Texas A and M Univ., College Station (USA). Dept. of Physics). 1984. Contract AS05-81ER40039. 71p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85004469.

The experimental high energy physics program at Texas A and M University has continued to make progress in carrying out its research programs begun over the past several years. The GUT magnetic monopole research program started in 1982 has reached the data taking stage within the last six months. The status of that experiment is presented, and preliminary results of this search are discussed. Secondly, our participation in the construction of the forward/backward hadron calorimeter systems for the Fermilab CDF project has begun to make significant progress, following the signing of our experimental agreement in April of this year. The status of our chamber construction and our plans for the coming year are reported. Lastly, efforts to participate in an international collaboration to search for GUT magnetic monopoles at the new Gran Sasso Laboratory under construction in Italy are reported.

9177 (NBI-HE—84-13) Recent developments in high psub(T) physics. Moeller, R. (Niels Bohr Inst., Copenhagen (Denmark)). 1984. 116p. NTIS (US Sales Only), PC A06/MF A01. File Number DE85700261.

From 23. Cracow School of Theoretical Physics; Zakopane (Poland) (Jun 1983).

Recent developments in high psub(T) hadron physics are reviewed. After a brief historical overview, the theoretical framework is sketched. The main emphasis of the paper is on new experimental results. These concern events with single hadrons and symmetric pairs of hadrons at large psub(T), direct photons, and other highly inelastic events, defined as events with a large transverse energy in an extended solid angle. Measurements of the inclusive cross section for jet production are treated in some detail. 115 refs.

9178 (RAL—84-026) Measurement of πip backward elastic differential cross-sections from 1.282 to 2.472 GeV/c. Candlin, D.J.; Lowe, D.C.; Peach, K.J. (Rutherford Appleton Lab., Chilton (UK)). Feb 1984. 32p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700262.

New high statistics measurements of π^+p elastic scattering differential cross-sections are presented at 30 momentum points between 1.282 and 2.472 GeV/c, covering most of the angular distribution outside the forward diffractive peak. These data show significant disagreements at some momenta with previous high statistics experiments and with current partial wave analyses.

9179 (RAL—84-032) Search for a threshold enhancement in the γp → charmed baryon + charmed meson cross section. Abe, K.; Bacon, T.C.; Bingham, H.H. (Rutherford Appleton Lab., Chilton (UK)). Mar 1984. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700263.

Submitted to Physical Review Letters.

Results of a search for a predicted enhancement of several microbarns in the charm photoproduction cross section just above threshold are reported. No charm decays were detected, from which an upper limit to the charm cross section of 94nb (90% CL) at Esub(γ) approx.= 10 GeV was obtained. Upper limits in the range 270 to 450nb were also obtained for the peak cross sections for threshold enhancements in γp → D^- Σ^+sub(c)$^+$ and similar channels.

9180 (TRI-PP—84-74) Search for massive neutrinos in the π-e nu decay. Numao, T.; Bryman, D.A.; Clifford, E.T.H.; Olin, A.; Schlatter, P.; Poutissou, J.M.; Macdonald, J.A.; Kitching, P.; Azuelos, G.; Dixit, M.S. (British Columbia Univ., Vancouver (Canada). TRIUMF Facility; Victoria Univ., British Columbia (Canada); Alberta Univ., Edmonton (Canada); Montreal Univ., Quebec (Canada); National Research Council of Canada, Ottawa, Ontario). Jul 1984. 11p. (CONF-840789—7). NTIS (US Sales Only), PC A02/MF A01. File Number DE85900289.

From International conference on particles and nuclei; Heidelberg, F.R. Germany (30 Jul 1984).

In an experiment to test mixing of electrons coupling with heavy neutrinos, a large background from the decay of pions to muons to electrons limits the sensitivity of the test. A new technique of reducing the pion to muon to electron chain decay background has been developed. Because of the lifetime, the early timing window with respect to a positive pion stop signal suppresses this background by more than a factor of 100. An additional factor is achieved by a cut on the total energy deposited in the target counter. An energy spectrum of positrons with cuts on the total energy is shown. These data were taken from a feasibility test experiment in which a positive pion beam of 85 MeV/c was stopped in a target counter and positrons were detected by a NaI detector. A suppression factor of 200 was obtained. (LEW)

9181 Measurement of the average B-hadron lifetime. Klem, D.E.; Dubois, R.; Young, C.C.; Atwood, W.B.; Baillon, P.H.; Barish, B.C.; Bonneaud, G.R.; Courau, A.; Donaldson, G.J.; Duro, M.M. (California Institute of Technology, Pasadena, California 91125 and Stanford Linear Accelerator Center and Physics Department Stanford University, Stanford, California 94305). *Physical Review Letters;* **53**: No. 20, 1873-1876(12 Nov 1984).

Results are reported from a study of the impact parameters of electrons in hadronic events produced at the PEP e^+e^- storage ring. Electrons in hadronic events are produced by bottom and charm decay and their impact parameters show hadrons containing bottom quarks to have a lifetime of 1.16/sub -0.34//sup +0.37/ (stat.) +- 0.23 syst.) psec. This result is used to constrain elements of the Kobayashi-Maskawa mixing matrix.

9182 Forward-angle elastic pp spin-depolarization and -rotation parameters at 0.8 GeV. Barlett, M.L.; Hoffmann, G.W.; McGill, J.A.; Fergerson, R.W.; Milner, E.C.; Marshall, J.A.; Amann, J.F.; Bonner, B.E.; McClelland, J.B. (Department of Physics, The University of Texas at Austin, Austin, Texas 78712). *Physical Review* [*Section*] *C: Nuclear Physics;* **30**: No. 1, 279-284(Jul 1984).

800 MeV elastic p+p spin-depolarization and -rotation parameters D/sub N/N, D/sub S/S, D/sub L/L, D/sub S/L, and D/sub L/S have been measured for the center-of-momentum angular range 4.8°—23.8° (0.26 fm^{-1}< or =q< or =1.28 fm^{-1}). Statistical uncertainties are ≃ +- 0.01—0.02 and total systematic uncertainty is < or = +- 0.035. The data are in overall agreement with predictions from global phase shift analysis.

6452 Particle Interactions And Properties - Theoretical

REFER ALSO TO CITATION(S) 6452009224, 9237, 9238, 9238, 9238, 9249, 9303

9183 **(DESY—84-037) Definition and statistical properties of a universal topological charge.** Berg, B.; Panagiotakopoulos, C. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). May 1984. 30p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85750085.

We consider the 2d 0(3) sigma-model. Lattice topological charge and universality are reconciled by an appropriate (quasi) local definition of the topological charge. Numerical calculations are carried out on square and triangular lattices. The results are satisfactory within limitations coming from the Monte Carlo method.

9184 **(DESY—84-040) Radiative corrections to Bhabha scattering in SU(2) x U(1).** Boehm, M.; Denner, A.; Hollik, W.; Sommer, R. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). May 1984. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85750089.

We present the results of an accurate investigation of the electromagnetic and weak radiative corrections to Bhabba scattering at PETRA/PEP energies and around the Z^0 in the electroweak standard model. Using the on shell renormalization scheme with the electric charge and the boson and fermion masses as renormalized parameters we find that the photonic corrections to the γ and Z^0 exchange contributions are the most important ones at PETRA energies, on resonance, ans in the radiative tail region above the Z^0. The fominating weak correction is the Z^0 self energy which gives visible effects around the resonance.

9185 **(DESY—84-045) Supersymmetric particles at the CERN panti p collider.** Ellis, J.; Kowalski, H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). May 1984. 25p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85750086.

We explore the experimental missing psub(T) signatures for s quark qtilde and gluino gtilde production at the CERN panti p Collider. We present topological cross-sections for gtildegtilde(anti qtilde) production followed by gtilde -> anti qγtilde (qtilde -> qγtilde) decay, applying criteria for the jet trigger and specification modelled on those used by UA1. Gluinos or s quarks with masses less than about 40 GeV give events with missing psub(T), predominantly one-jet events, -fewer two- and multijet events. We use the observed monojet events as an upper limit implying msub(g)tilde (msub(q)tilde) > or approx. 40 GeV. The observed one- and multijet events could be due to the production of gtildegtilde or qtildeanti qtilde with msub(g)tilde or msub(q)tilde = 0(40)GeV. The small invariant masses of the observed monojets and their hard missing psub(T) spectrum favour a qtilde interpretation. Predictions are presented for msub(g)tilde or msub(q)tilde up to 60 GeV which could be detectable in forthcoming data from the CERN panti p collider.

9186 **(DESY—84-046) Monopole-fermion and dyon-fermion bound states. Pt. 1.** Osland, P.; Wu, T.T. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). May 1984. 46p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85750081.

General properties of monopole-fermion and dyon-fermion bound states are investigated, for the case of Dirac monopoles and their dyon analogues. The attractive forces that lead to bound states are due to the interaction of a fermion anomalous magnetic moment with the monopole magnetic field and the additional Coulomb interaction in the dyon case. Detailed numerical results are presented.

9187 **(DESY—84-047) Monopole-fermion and dyon-fermion bound states II: Weakly bound states for the lowest angular momentum.** Osland, P.; Wu, T.T. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). May 1984. 29p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85750083.

We investigate weakly bound dyon-fermion states of the lowest angular momentum. Both Coulomb attraction and Coulomb repulsion are studied. Binding energies are given by a transcendental equation which is solved explicitly in a number of limiting cases. Normalized wave functions are given in terms of Bessel functions and confluent hypergeometric functions.

9188 **(DESY—84-066) Classical models of confinement. Pt. 2.** Lehmann, H.; Wu, T.T. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Jul 1984. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number TI85750481.

We generalize the class of Abelian models of paper I which lead to a linear potential between opposite charges. The electric field E is here taken as a power series in the electric displacement D raised to the sigmasup(th) power. We solve to first order the case of two opposite static point charges asymptotically for large separations.

9189 **(FNAL/Pub—84/110-A) Cosmological constraints on the properties of weakly interacting massive particles.** Steigman, G.; Turner, M.S. (Delaware Univ., Newark (USA). Bartol Research Foundation; Chicago Univ., IL (USA). Enrico Fermi Inst.; Fermi National Accelerator Lab., Batavia, IL (USA)). Oct 1984. Contract AC02-76CH03000. 12p. NTIS, PC A02. File Number DE85003921.

Considerations of the age and density of, as well as the evolution of structure in, the Universe lead to constraints on the masses and lifetimes of weakly interacting massive particles (WIMPs). 26 references.

9190 **(FRNC-TH—1420) Effective cross-section for dimuon production and experimental determination of the hadronic structure functions.** Weisz, S. (Paris-11 Univ., 91 - Orsay (France)). Jul 1982. 196p. (In French). NTIS (US Sales Only), PC A09/MF A01. File Number DE84752342.

High mass dimuon hadronic production is studied. This study is aimed at pion structure determination. The device is presented. The accessible luminosity is more than one scale order beyond the preceeding experiment one. The performant beam, the great acceptance and the good high mass dimuon selection are described. Parton model is introduced. Drell-Yann mechanism is reviewed. Hadronic structure, revealed during high mass muon pair production, is presented. In particular, pion structure is determined.

9191 **(IC—83/219) Inclusive F(cs-bar) hadroproduction.** Hussain, F.; Khan, K.; Mahmood, S.; Rashid, K. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1983. 21p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700247.

We present a leading order perturbative QCD calculation of the F meson hadroproduction and evaluate the central and diffractive production cross sections under current and Tevatron Fermilab energies.

9192 **(IC—83/221, pp 112-149) Magnetic monopole.** Coleman, S. (Harvard Univ., Cambridge, MA (USA). Lyman Lab. of Physics). Nov 1983. NTIS (US Sales Only), PC A24/MF A01. File Number DE85780364. (CONF-8306247—).

From 3. annual ICTP summer workshop on particle physics; Trieste, Italy (20 Jun 1983).

A condensed form of the lectures (the sketches), nevertheless rather clear, which presents the status of the theory of the monopoles after some fifty years of development. The gauge invariance and Yang-Mills theory are first reviewed. Then, the dynamical (GNO) classification as well as the topological (Lubkin) one, of the monopoles, are presented. The problem of stability is discussed and different applications and examples are worked out. Finally, the properties of the grand unified monopoles are considered.

9193 (IC—83/221, pp 151-160) **Current algebra, baryons and quark confinement.** Witten, E. (Princeton Univ., NJ (USA). Joseph Henry Labs.). Nov 1983. NTIS (US Sales Only), PC A24/MF A01. File Number DE85780364. (CONF-8306247—).

From 3. annual ICTP summer workshop on particle physics; Trieste, Italy (20 Jun 1983).

It is shown that ordinary baryons can be understood as solitons in current algebra effective lagrangians. The formation of color flux tubes can also be seen in current algebra, under certain conditions.

9194 (IC—83/221, pp 399-459) **Preons and their implications for the next-generation accelerators.** Pati, J.C. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Nov 1983. NTIS (US Sales Only), PC A24/MF A01. File Number DE85780364. (CONF-8306247—).

From 3. annual ICTP summer workshop on particle physics; Trieste, Italy (20 Jun 1983).

The lectures discuss the following topics: (i) The need for "preons" as constituents of quarks and leptons; (ii) Peculiarities of preon dynamics; (iii) The flavon-chromon preonic models; (iv) Preons, pre-preons and supersymmetry; (v) Dynamical symmetry breaking through preons. Advantages over technicolor theories - a prediction for the sizes of quarks and leptons - experimental signals; (vi) The issue of chiral symmetry preservation for quantum preon dynamics (QPD). The possibility that chiral symmetry is in fact violated by QPD in a manner which is analogous, at least qualitatively, to that in QCD - contrary to the commonly held belief; (vii) The problem of fermion mass hierarchies; (viii) Open problems.

9195 **(IC—83/224) Recent single tag two photon experiments at PETRA and the issue of quark charges.** Godbole, R.M.; Pati, J.C.; Rindani, S.D.; Jayaraman, T.; Rajasekaran, G. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1983. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700248.

The data of recent single-tag-two-photon experiments indicating noticeable excess in (R-tildesub($\gamma\gamma$))sup(jet) over fractionally charged quark-parton model-predictions is studied from the point of view of its implications on the gauge integer charge quark model. Focussing attention on the region of psub(T) exceeding about 3 GeV, where higher order QCD and non-perturbative effects might be expected to be small, it is noted that this excess and its Q^2 dependence can be attributed to the presence of a colour component in the electromagnetic current provided the effective mass of the gluon lies between about 150 to 350 MeV. Accurate measurements of R-tildesub($\gamma\gamma$) in the high psub(T) region (psub(T)>or approx.5 GeV) are crucial for an unambiguous distinction between fcq and gauge-icq models.

9196 **(IFIN-FT—211-1982) Towards an optimum principle in hadron-hadron scattering.** Ion, D.B. (Institutul Central de Fizica, Bucharest (Romania)). Apr 1982. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700257.

Information on the helicity amplitudes are obtained assuming that the hadron-hadron scattering behaves so as to optimize the forward unpolarized cross section when the integrated elastic cross section is fixed. Then, the diffraction behaviour as well as the scaling properties of the angular distributions are well reproduced by the optimal model prediction. The predictions on the logarithmic slope diffraction peak are satisfied experimentally to a surprising accuracy for all pp, anti-p p, k^{+-} p and π^{+-} p scattering at all energies higher than 2 GeV.

9197 (INIS-mf—9078, pp 145-162) **Wave, particle-family duality and the conservation of discrete symmetries in strong interaction.** Van der Spuy, E. (Nuclear Development Corp. of South Africa (Pty.) Ltd., Pelindaba, Pretoria). 1984. NTIS (US Sales Only), PC A18/MF A01. File Number TI85780085. (CONF-8307139—; CONF-8207113—).

From 18. annual seminar on theoretical physics; Pretoria, South Africa (11 Jul 1983).

This paper starts from a nonlinear fermion field equation of motion with a strongly coupled selfinteraction. Nonperturbative quark solutions of the equation of motion are constructed in terms of a Reggeized infinite component free spinor field. Such a field carries a family of strongly interacting unstable compounds lying on a Regge locus in the analytically continued quark spin. Such a quark field is naturally confined and also possesses the property of asymptotic freedom. Furthermore the particular field selfregularizes the interactions and naturally breaks the chiral invariance of the equation of motion. We show why and how the existence of such a strongly coupled solution and its particle-family, wave duality forces a change in the field equation of motion such that it conserves C, P, T although its individual interaction terms are of V - A and thus C, P nonconserving type.

9198 **(NBI-HE—84-07) Critical behaviour in a model of planar random surfaces.** Durhuus, B.; Froehlich, J.; Jonsson, T. (Niels Bohr Inst., Copenhagen (Denmark)). 1984. 55p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85700258.

The authors solve a model of planar random surfaces exactly in the sense that, by assuming that the susceptibility diverges at a critical point, they determine the critical exponents and the Hausdorff dimension, and show that the string tension does not tend to zero at the critical point. (The assumption that the susceptibility diverges has been verified numerically in 2 and 3 dimensions and proven for d = infinity).

9199 **(NBI-HE—84-16) Semi-hard physics at the SPS p anti p collider.** Dias de Deus, J. (Niels Bohr Inst., Copenhagen (Denmark)). Apr 1984. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700249.

The geometrical model framework is used in simulating the role played by the increasing number of hard partons in soft hadron interactions. A set of closely related physical parameters is proposed to measure violations of Geometrical Scaling, violations of KNO scaling and psub(T),n correlations. A qualitative description of existing Collider data is achieved.

9200 **(NBI-HE—84-23) Quark clusters in nuclei and QCD evolution.** Dias de Deus, J.; Pimenta, M.; Varela, J. (Niels Bohr Inst., Copenhagen (Denmark)). Jun 1984. 10p. (CONF-8406221—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700250.

From 7. international seminar on high energy physics problems, multiquark interactions and quantum chromodynamics; Dubna, USSR (19 Jun 1984).

The evidence for cluster and confinement size differences in particles and nuclei is discussed. A simple model for structure functions in the $0 < x < 1$ region is proposed.

9201 **(NIKHEF-H—84-5) Comment on the electric potentials of the nucleon.** Wolters, G.F. (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H). Apr 1984. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700252.

The electric potential is considered which corresponds to the empirical dipole charge form factor of the proton. This potential is in support of the charge symmetric quark model approach to nucleon form factors. The corresponding potentials for proton and neutron are obtained in that model. The neutron potential has a range less than the hardronic size. It shows, like the proton potential, little variation deep inside, where V=0.3 and 3 MV respectively. 4 figs.; 8 refs.

9202 (RAL—84-009, pp 120-155) **Introduction to the electro-weak theory.** Hey, A.J.G. (Southampton Univ. (UK)). 1984. NTIS (US Sales Only), PC A09/MF A01. File Number DE85780365. (CONF-8309300—).

From School for young high energy physicists; Chilton, UK (11 Sep 1983).

The lecture reviews electro-weak theory, beginning with the Fermi theory in 1934 to the recent Glashow-Salam-Weinberg theory. Weak interactions, hadronic weak current and neutral currents, Feynman rules, weak interaction phenomenology, gauge invariance and hidden gauge invariance are all discussed in detail.

9203 **(RAL—84-040) Chiral quarks and proton decay.** Chadha, S.; Daniel, M.; Gounaris, G.J.; Murphy, A.J. (Rutherford Appleton Lab., Chilton (UK)). Apr 1984. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700254.

The authors calculate the hadronic matrix elements of baryon decay operators using a chiral effective Lagrangian with quarks, gluons and Goldstone boson fields. The cases where the $\Delta B=1$ operators arise from supersymmetric SU(5) GUT as well as the minimal SU(5) GUT model are studied. In each model the results depend on two parameters. In particular there is a range of values for the two parameters, where the dominant decay modes in the minimal SU(5) GUT are: $p \rightarrow e^+ a e^+$ and $n \rightarrow \pi^- e^+$.

9204 **(RAL—84-046) Exotic atoms of QCD: glueballs, hybrids and baryonia.** Barnes, T. (Rutherford Appleton Lab., Chilton (UK)). May 1984. 24p. (CONF-8403159—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700255.

From School of physics of exotic atoms; Erice, Italy (31 Mar 1984).

The theoretical basis underlying the expected "exotic" states in QCD, the theory of quarks and gluons, is reviewed in three lectures. The first lecture is an historical introduction to QCD. The second lecture is a critical review of the MIT bag model and QCD on a lattice. The status of three candidate "exotic" states seen in psi radiative decays, the i(1440), O(1700) and zeta(2220) are discussed in the third lecture.

9205 **(RAL—84-055) psi → γγV and M1 radiative decays of iota(1440) and QQ-barG hybrid mesons.** Barnes, T.; Close, F.E. (Rutherford Appleton Lab., Chilton (UK)). Jun 1984. 7p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700256.

The authors show that psi → γγrho and γγphi can test the glue or qq-bar content of iota(1440). If iota is a glueball then psi → γγphi and psi → γγrho will show similar distributions in the γV invariant mass; if iota contains qq-bar then γphi and γrho distributions will differ. The possibility of identifying hybrid qq-barg states via electromagnetic transitions such as psi → γH → γγV and γγ → Hsub(n) is debated.

9206 **(TRI-PP—84-60) Paris potential model results for proton-proton bremsstrahlung.** Workman, R.L.; Fearing, H.W. (British Columbia Univ., Vancouver (Canada). TRIUMF Facility). Jul 1984. 14p. (CONF-840789—6). NTIS (US Sales Only), PC A02/MF A01. File Number DE85900220.

From International conference on particles and nuclei; Heidelberg, F.R. Germany (30 Jul 1984).

In order to better understand the problems plaguing the potential model approach to ppγ, a modern calculation of ppγ cross sections and asymmetries has been undertaken. Results are presented for the Paris potential and an extended version of the Reid soft core potential, neither potential having been used in previous ppγ calculations. In addition, this calculation combines the contributions due to relativistic spin corrections, Coulomb effects, and high partial waves from the 1-π exchange. Results indicate that the use of a modern potential, in conjunction with the correction terms considered, still produces results that are in poor agreement with the available data. (LEW)

9207 **Force between static charges and universality in lattice QCD.** Barkai, D.; Moriarty, K.J.M.; Rebbi, C. (Control Data Corporation at the Institute for Computational Studies at CSU, P.O. Box 1852, Fort Collins, Colorado 80522). *Physical Review* [*Section*] *D: Particles and Fields;* **30**: No. 10, 2201-2211(15 Nov 1984).

We present Monte Carlo results for the force between static quarks on a large ($16^3 \times 32$) lattice and with high statistics, obtained by using an action which combines terms in the fundamental and adjoint representations of SU(3). We discuss universality with respect to the choice of the action, which appears to be well verified, and propose a phenomenological formula for the force as a function of separation.

9208 **Model dependence of peripheral NN phase parameters at medium energy.** Kloet, W.M.; Tjon, J.A. (Department of Physics and Astronomy, Rutgers University, New Brunswick, New Jersey 08903). *Physical Review* [*Section*] *C: Nuclear Physics;* **30**: No. 5, 1653-1661(Nov 1984).

The model dependence of high L partial waves in nucleon-nucleon scattering for T/sub lab/ = 400—1000 MeV is studied. Unlike at low energy, model predictions are not unique. This is due to the delta isobar, which plays a major role in determining high L inelasticities as well as real phase shifts. The differences between various model predictions are mainly due to the use of different delta propagators and delta vertex functions.

6453 Particle Invariance Principles And Symmetries

REFER ALSO TO CITATION(S) 6453009239

9209 **(IC—83/163) Dimensional reduction of exceptional E_6, E_8 gauge groups and flavour chirality.** Koca, M. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1983. 5p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700204.

10-dimensional Yang-Mills gauge theories based on the exceptional groups E_6 and E_8 are reduced to 4-dimensional flavour-chiral-Yang-Mills-Higgs theories where the extra six dimensions are identified with the compact $G_2/SU(3)$ and $SO(7)/SO(6)$ coset spaces. A 10-dimensional E_8 theory leads to three families of SU(5) one of which lies in 144 dimensional representation of SO(10).

9210 (IC—83/221, pp 170-186) **Static properties of nucleons in the Skyrme model.** Adkins, G.S.; Witten, E. (Princeton Univ., NJ (USA). Joseph Henry Labs.); Nappi, C.R. (Institute for Advanced Study, Princeton, NJ (USA)). Nov 1983. NTIS (US Sales Only), PC A24/MF A01. File Number DE85780364. (CONF-8306247—).

From 3. annual ICTP summer workshop on particle physics; Trieste, Italy (20 Jun 1983).

We compute static properties of baryons in an SU(2)xSU(2) chiral theory (the Skyrme model) whose solitons can be interpreted as the baryons of QCD. Our results are generally within about 30% of experimental values. We also derive some relations that hold generally in soliton models of baryons, and therefore, serve as tests of the 1/N expansion.

9211 **(NBI-HE—84-25) Non-abelian chiral anomalies and Wess-Zumino effective actions.** Petersen, J.L. (Niels Bohr Inst., Copenhagen (Denmark)). Jun 1984. 50p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700259.

From 24. Cracow School of Theoretical Physics; Zakopane (Poland) (1984).

An elementary account is given of the construction of anomalies and effective actions for Goldstone bosons, using the techniques of differential geometry. The emphasis is on simplicity of presentation, comparison of different renormalization schemes and the relationship to bosonization in the case of 2 dimensions.

9212 **(NIKHEF-H—84-7) π^+-π^0 mass difference at finite temperature.** Kapusta, J.I.; Visnjic, V. (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H). Jun 1984. 8p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700253.

The electromagnetic mass difference of pions at finite temperature is computed. The finite temperature contribution to the quadratic mass difference of charged and neutral pions is obtained to be $\pi\alpha T^2$, neglecting the corrections due to the rho and A_1 mesons. It has the same sign as the zero temperature value and is comparable to it in magnitude around T = 200 MeV. The calculation is also done in case of supersymmetric QCD where it is known that the mass difference is zero at T = 0. The results may have implications for cosmology and for relativistic heavy ion collisions.

6454 Field Theory

REFER ALSO TO CITATION(S) 6454009131, 9183, 9192, 9193, 9198, 9207

9213 **(DESY—84-044) Energy-momentum spectrum in local field theories with broken Lorentz-symmetry.** Borchers, H.J.; Buchholz, D. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). May 1984. 26p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85750084.

Assuming locality of the observables and positivity of the energy it is shown that the joint spectrum of the energy-momentum operators has a Lorentz-invariant lower boundary in all superselection sectors. This result is of interest if the Lorentz-symmetry is (spontaneously) broken, such as in the charged sectors of quantum electrodynamics.

9214 **(IC—83/47) Derivation of the U(1) radial Schwinger model action used in the analysis of monopole induced fermion number violating processes.** Craigie, N.S. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1983. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700201.

Starting from the path integral description of the quantum fluctuations around a 't Hooft-Polyakov monopole, we give a derivation of the radial two-dimensional Schwinger model action used in the discussion of the fermion vacuum around the monopole core.

9215 **(IC—83/218) Pseudoparticle solutions in the Poincare gauge theory of gravity.** Mielke, E.W. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1983. 35p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700195.

The dynamical structure of the Poincare gauge field theory coupled to matter fields and some of its implications for a quantum theory of gravity are investigated. Essentially, the method of Belavin et al. for generating instanton solutions in Yang-Mills theory is transferred to the gravitational gauge model. The results are as follows: For configurations obeying a modified double duality Ansatz for the curvature the metrical background is determined by Einstein-type field equations coupled almost canonically to the stress-energy content of external fields. Exact electrovac solutions with non-trivial torsion are derived from the duality Ansatz. In a Euclidean space-time the corresponding pseudoparticle solutions are expected to play a dominant role in the quantization of gravity via Feynman's method of path integrals. 66 refs.

9216 **(IC—83/220) Spectrum of the eleven dimensional supergravity compactified on the round seven sphere.** Sezgin, E. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1983. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700196.

We report results on the particle spectrum of the d=11 supergravity compactified on AdScircled-xS^7. Our method is to use Salam-Strathdee type harmonic expansions on S^{4}circled-xS^7 and to calculate the propagator. We then examine the poles in the propagator and exploit a close relationship between the SO(5) Casimir labels and those of SO(3,2), to interpret the physical states in terms of Fronsdal's positive energy representations. The resulting spectrum is arranged into supermultiplets labelled by an integer l=0,1,2,...,infinity. The massless supermultiplet corresponds to l=0. In addition, a singleton representation seems to emerge for l=-1. It consists of an 8-plet of spin-0 and an 8-plet of spin-1/2 particles.

9217 (IC—83/221, pp 287-311) **Introduction to superstrings.** Witten, E. (Princeton Univ., NJ (USA). Joseph Henry Labs.). Nov 1983. NTIS (US Sales Only), PC A24/MF A01. File Number DE85780364. (CONF-8306247—).

From 3. annual ICTP summer workshop on particle physics; Trieste, Italy (20 Jun 1983).

The paper contains lecture notes on the superstring theory (in ten dimensions), which would appear at the moment to be the one real contender as a renormalizable, physically sensible quantum theory of gravity.

9218 (IC—83/221, pp 188-259) **Kaluza-Klein approach to supergravity.** Duff, M.J. (Imperial Coll. of Science and Technology, London (UK). Blackett Lab.). Nov 1983. NTIS (US Sales Only), PC A24/MF A01. File Number DE85780364. (CONF-8306247—).

From 3. annual ICTP summer workshop on particle physics; Trieste, Italy (20 Jun 1983).

The sketches of six lectures and an extensive list of references are given. The superunification from 11 dimensions is justified in detail, with emphasis on spontaneous compactification and broken supersymmetries. Solutions with the sevensphere topology are then discussed. A realistic theory aiming at obtaining a SU(3)xSU(2)xU(1) unification theory is presented. Finally, the cosmological constant problem is discussed. 45 refs.

9219 (IC—83/221, pp 260-286) **Round and squashed seven spheres.** Pope, C. (Imperial Coll. of Science and Technology, London (UK)). Nov 1983. NTIS (US Sales Only), PC A24/MF A01. File Number DE85780364. (CONF-8306247—).

From 3. annual ICTP summer workshop on particle physics; Trieste, Italy (20 Jun 1983).

Brief lecture notes are given on the seven-sphere topology. The problems treated are: killing spinors, torsion, spectra of operators on the seven-sphere, and obtaining Kaluza-Klein supergravity solution.

9220 (IC—83/221, pp 161-169) **Global aspects of current algebra.** Witten, E. (Princeton Univ., NJ (USA). Joseph Henry Labs.). Nov 1983. NTIS (US Sales Only), PC A24/MF A01. File Number DE85780364. (CONF-8306247—).

From 3. annual ICTP summer workshop on particle physics; Trieste, Italy (20 Jun 1983).

A new mathematical framework for the Wess-Zumino chiral effective action is described. It is shown that this action obeys an a priori quantization law, analogous to Dirac's quantization of magnetic change. It incorporates in current algebra both perturbative and non-perturbative anomalies.

9221 (IC—83/221, pp 331-349) **Status of the Rubakov-Callan effect.** Craigie, N.S. (International Centre for Theoretical Physics, Trieste (Italy); Istituto Nazionale di Fisica Nucleare, Trieste (Italy)). Nov 1983. NTIS (US Sales Only), PC A24/MF A01. File Number DE85780364. (CONF-8306247—).

From 3. annual ICTP summer workshop on particle physics; Trieste, Italy (20 Jun 1983).

In this review we try to bring together the various approaches that are being developed to analyze what happens when fermions scatter off monopoles in grand unified theories. The material is divided according to the following table of contents.

9222 (IC—83/221, pp 355-381) **Solitons and the phase structure of lattice gauge theories.** Schwimmer, A. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Physics). Nov 1983. NTIS (US Sales Only), PC A24/MF A01. File Number DE85780364. (CONF-8306247—).

From 3. annual ICTP summer workshop on particle physics; Trieste, Italy (20 Jun 1983).

The phase structure of compact U(1) as well as SU(N)/Z(N) lattice gauge theories is discussed. The presence of topologically stable Z(N) monopoles is shown, and discussed in connection with possible phase transitions.

9223 (IC—83/221, pp 384-398) **Spontaneously broken gauge theories as weakly coupled low energy effective Lagrangians for ASF confining preon gauge theories.** Craigie, N.S. (International Centre for Theoretical Physics, Trieste (Italy); Istituto Nazionale di Fisica Nucleare, Trieste (Italy)). Nov 1983. NTIS (US Sales Only), PC A24/MF A01. File Number DE85780364. (IC—83/183; CONF-8306247—).

From 3. annual ICTP summer workshop on particle physics; Trieste, Italy (20 Jun 1983).

A discussion is given of a framework in which one supposes an asymptotically free preon gauge theory leads to a weakly coupled gauge theory of the Glashow-Salam-Weinberg type as a low energy effective Lagrangian for the ground state sector. Starting from a general preon gauge theory, involving some meta colour group, one shows that there is a definite approximation, in which the current algebra and the short-distance properties of its Lagrangian are reproduced by the weakly coupled effective Lagrangian. The prospect of extending these considerations to supersymmetric versions of the class of preon models is also discussed.

9224 (IC—83/221, pp 2-110) **Applied N=1 supergravity.** Nath, P.; Chamseddine, A.H. (Northeastern Univ., Boston, MA (USA). Dept. of Physics); Arnowitt, R. (Harvard Univ., Cambridge, MA (USA). Lyman Lab. of Physics). Nov 1983. NTIS (US Sales Only), PC A24/MF A01. File Number DE85780364. (CONF-8306247—).

From 3. annual ICTP summer workshop on particle physics; Trieste, Italy (20 Jun 1983).

A review of recent developments in the applications of N=1 Supergravity to the construction of unified models of elementary particle interactions is given. Couplings of N=1 Supergravity with matter consisting of an arbitrary set of left handed multiplets and a gauge multiplet are discussed. General formulation of spontaneous symmetry breaking and the criteria for breaking of internal symmetry and of local supersymmetry are described. Construction of specific Supergravity GUT models, the gauge heirarchy in GUT models and a deduction of the low energy effective potential are discussed. The phenomena of SU(2)XU(1) electro-weak gauge invariance breakdown by Supergravity in tree models and by radiative corrections using renormalization group methods are described. Model independent formulations of low energy physics which encompass tree and the renormalization group methods of breaking SU(2)XU(1), but also allow more general scenarios are discussed. The particle content of Supergravity unified theories at low energy is given which includes predictions, for a class of supergravity models, of light gauge fermions, i.e. of a charged Dirac fermion, the Wino, with a mass below the W boson mass and a neutral fermion, the Zino, below the mass of the Z boson mass. "Direct" gaugino masses arising from loops for the photino and the gluino, (which are massless at the tree level) are exhibited. Decays of the W and Z into photino, Wino, and Zino modes and their branching ratios into various channels are given. Experimental signals for the supersymmetric decays are discussed and some prominent signatures such as decays into one and two jets with unbalanced energy and momentum are pointed out. The current status of the p-parameter, including supergravity GUT effects is given. Other experimental consequences of supergravity unified theories are also discussed. 108 refs.

9225 **(IC—83/225) QFT of monopole induced baryon number violating processes including non-Abelian forces.** Craigie, N.S. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1983. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700199.

A brief summary is given of an attempt to develop a complete QFT treatment of monopole-induced baryon number-violating processes, based on techniques developed for two-dimensional Abelian and non-Abelian field theories.

9226 **(IC—83/226) Stability of instanton induced compactification in 8-dimensions.** Randjbar-Daemi, S.; Salam, A.; Strathdee, J. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1983. 32p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700200.

We consider the 8-dimensional Einstein-SU(2) Yang-Mills system when the Yang-Mills system assumes a 1-instanton configuration on an internal S_4 with the vacuum solution possessing the geometry of M_4xS_4 and the invariance group P_4(Poincare)xSO(5). We demonstrate the classical stability of the solution by computing the spectrum of the physical states and showing the absence of ghosts and tachyons amongst them. We also discuss the possibility of obtaining SO(5) multiplets of massless fermions.

9227 (INIS-mf—9078, pp 109-144) **Quarks and fields.** Henning, J.J. (Nuclear Development Corp. of South Africa (Pty.) Ltd., Pelindaba, Pretoria). 1984. (In Afrikaans). NTIS (US Sales Only), PC A18/MF A01. File Number TI85780085. (CONF-8307139—; CONF-8207113—).

From 18. annual seminar on theoretical physics; Pretoria, South Africa (11 Jul 1983).

In this lecture the experimental facts about hadrons are summarized after which an elementary introduction to SU (3) classification is given. The quark quantum numbers are introduced and an introductory discussion of gauge fields is presented. The QCD Lagrangian is derived and the concepts of confinement and asymptotic freedom are introduced.

9228 (INIS-mf—9078, pp 223-231) **Fully crossing symmetric vertex function.** Gering, M.Z.I. (University of the Witwatersrand, Johannesburg (South Africa). Dept. of Physics). 1984. NTIS (US Sales Only), PC A18/MF A01. File Number TI85780085. (CONF-8307139—; CONF-8207113—).

From 18. annual seminar on theoretical physics; Pretoria, South Africa (11 Jul 1983).

The four point vertex function, denoted by GAMMA plays a central role in the non-relativistic many-body formalism. In particular, by obeying Bethe-Salpeter equations corresponding to three interaction channels, GAMMA displays crossing symmetry - the mutual blending of the A+2 to A-2 particle systems. The four point formalism is reviewed and an exact, hence crossing symmetric, vertex function is presented. Some novel features emerge concerning the structure of GAMMA and its irreducible parts.

9229 (INIS-mf—9078, pp 173-222) **Symmetry breaking in many-body systems.** De Vries, J.P.; Engelbrecht, C.A. (Stellenbosch Univ. (South Africa). Dept. of Physics). 1984. (In Afrikaans). NTIS (US Sales Only), PC A18/MF A01. File Number TI85780085. (CONF-8307139—; CONF-8207113—).

From 18. annual seminar on theoretical physics; Pretoria, South Africa (11 Jul 1983).

After a short review of the Lagrange formalism in quantum field theory, a brief discussion is presented of invariance under continuous transformations, of local symmetries and gauge fields, of spontaneous symmetry breaking, hidden symmetry and Goldstone-bosons, and finally of the Higgs mechanism by means of which the spontaneous breaking of gauge symmetries manifests itself. The various conditions entering into the proof of the Goldstone theorem relativistically and in non-relativistic systems are discussed. These aspects are illustrated by means of the ferromagnet and the plasmon. Further examples of Goldstone excitations are given in terms of the Kibble model, the boson gas and the fermion gas.

9230 (INIS-mf—9078, pp 395) **Convergence of the perturbation expansion for the unitary crossing-symmetric vertex function.** Davis, E.D. (University of the Witwatersrand, Johannesburg (South Africa). Dept. of Physics). 1984. NTIS (US Sales Only), PC A18/MF A01. File Number TI85780085. (CONF-8307139—; CONF-8207113—).

From 18. annual seminar on theoretical physics; Pretoria, South Africa (11 Jul 1983).

9231 **(NBI-HE—84-24) Rotation invariant regularization of quantum chromodynamics in strong coupling.** Schlereth, H. (Niels Bohr Inst., Copenhagen (Denmark)). Jul 1984. 7p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700251.

From 23. International universities week for nuclear physics; Schladming (Austria) (1984).

The author presents a regularization of strong coupling QCD which is rotation invariant and suggests its Hamiltonian formulation to be used in practical calculations. Dynamical fermions are introduced. The fermion doubling problem is seemingly avoided.

9232 **(NBI-HE—84-27) Momentum-space Monte Carlo.** Amundsen, P.A.; Greensite, J.; Sterling, T. (Niels Bohr Inst., Copenhagen (Denmark)). Jul 1984. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700202.

Using the quenched, reduced form of large-N field theories, the authors show that it is possible to directly measure momentum-space Green functions, via Monte Carlo, without going through the intermediate step of measurement in position space plus Fourier transformation. This promises to be a useful tool for investigating the infrared structure of planar field theories. As an application (and test) of the method, the authors compute mass-gaps in the quenched U(N) x U(N) lattice chiral model, in D = 1 and 2 dimensions.

9233 **(NBI-HE—84-28) Some properties of the layer phase.** Fu, Y.K.; Nielsen, H.B. (Niels Bohr Inst., Copenhagen (Denmark)). Jul 1984. 71p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85700203.

There exists a layer phase at least in the non-isotropic U(1) lattice gauge field model for lattice dimension D >= 5 and layer dimension d = D - 1. The authors analyze some of the main properties of the layer phase. These are as follows: the behaviour of massless gauge particles (photons); the behaviour of doubly-sign charged particles and the behaviour of Wilson loops. A non-isotropic O(N) model is suggested and analyzed too. It is proved that in this case there exists no layer phase. Finally a model involving a non-isotropic antisymmetric tensor gauge field of arbitrary order is studied and a criterion for the dimensionality of the layer phase is given.

9234 **(NBI-HE—84-33) Generation of composite operators in supergravity.** Abdalla, E. (Niels Bohr Inst., Copenhagen (Denmark)). Jul 1984. 16p. (CONF-8404207—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700260.

From Workshop on supersymmetry, supergravity and Kaluza-Klein theories; Trieste, Italy (16 Apr 1984).

The author discusses the generation of quantum composite operators in two and higher dimensions. In two dimensions the problem is discussed in detail, and the supergravity fields, trivial at the beginning, acquire the status of independent fields, non trivial features being obtained as consequence. In higher dimensions one is led to non compact symmetry groups when dealing with supergravity. The symmetry SU(p,q) is discussed; quantization presents several problems. In one case, p=q, it is possible to obtain a prescription leading to finite results, with a quantization procedure breaking the symmetry to SU(p) X SU(q).

9235 **(NIKHEF-H—84-6) Introduction to supergravity.** Wit, B. de. (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H). Jun 1984. 39p. (CONF-8404206—1). NTIS (US Sales Only), PC A03/MF A01. File Number DE85700198.

From Spring school on supersymmetry and supergravity; Trieste, Italy (4 Apr 1984).

These lectures aim at introducing supergravity in its most simple and direct form. After explaining the main features of graviton and gravitino fields the invariance of simple supergravity in d=4 dimension is proved. The complications for higher-dimensional supergravity are explained and d=11 supergravity is presented. The author discusses supersymmetry in anti-de Sitter space, which allows him to introduce the concept of isometries and Killing spinors and vectors. The breaking of supersymmetry (super-Brout-Englert-Higgs effect), off-shell aspects of supergravity and the superconformal multiplet calculus are dealt with. This is first done for gravity, but also for the structure of simple d=4 conformal supergravity. Finally, the coupling of scalar fields to N=1 and N=2 supergravity as an application of this formalism is discussed. 3 tables; 35 refs.

9236 (RAL—84-009, pp 1-59) **Introduction to QED.** Martin, A.D. (Durham Univ. (UK)). 1984. NTIS (US Sales Only), PC A09/MF A01. File Number DE85780365. (CONF-8309300—).

From School for young high energy physicists; Chilton, UK (11 Sep 1983).

The lecture concerns quantum electrodynamics (QED), the relativistic quantum theory of electromagnetic interactions. Antiparticles, electrodynamics of spinless particles, the dirac equation and electrodynamics of spin 1/2 particles are discussed in detail.

9237 (RAL—84-009, pp 61-118) **New ABC of QCD.** Pennington, M.R. (Durham Univ. (UK)). 1984. NTIS (US Sales Only), PC A09/MF A01. File Number DE85780365. (CONF-8309300—).

From School for young high energy physicists; Chilton, UK (11 Sep 1983).

The lecture is concerned with quantum chromodynamics, which has become the language of the hadron world. Quarks, partons, quantum chromodynamics, $e^+e^- \rightarrow$ hadrons and inelastic scattering are discussed in detail.

9238 (RAL—84-009, pp 158-192) **Topics in modern phenomenology.** Scott, D.M. (Cambridge Univ. (UK)). 1984. NTIS (US Sales Only), PC A09/MF A01. File Number DE85780365. (CONF-8309300—).

From School for young high energy physicists; Chilton, UK (11 Sep 1983).

The lecture deals with quantum chromodynamics and the Glashow-Salem-Weinberg model, and how these models can be used to describe experimental data. A small number of topics in modern phenomenology are reviewed. These include the parton model, Drell-Yan process, W,Z properties and production, high transverse momentum processes, and heavy quark systems.

9239 **Locally supersymmetric cosmology and the gauge hierarchy.** Ovrut, B.A.; Steinhardt, P.J. (Department of Physics, The Rockefeller University, New York, New York 10021). *Physical Review* [*Section*] *D: Particles and Fields;* **30**: No. 10, 2061-2066(15 Nov 1984).

We motivate and present a locally supersymmetric theory that satisfies all the constraints for a successful, new inflationary-universe scenario, and has a naturally light gravitino. The reheating temperature is sufficiently high to explain the observed baryon asymmetry.

9240 **Vanishing axial anomaly for nonlocal lattice gauge theories.** Ninomiya, M.; Tan, C. (Department of Physics, Brown University, Providence, Rhode Island 02912). *Physical Review Letters;* **53**: No. 17, 1611-1614(22 Oct 1984). Contract AC02-76ER03130.

A nonperturbative procedure for testing for the presence of proper axial anomalies is introduced for lattice gauge theories. We prove, in particular, that the nonlocal theory of Drell, Weinstein, and Yankielowicz produces a vanishing axial anomaly.

9241 **String, corner, and plaquette formulation of finite lattice gauge theory.** Batrouni, G.G.; Halpern, M.B. (Laboratory of Nuclear Studies, Cornell University, Ithaca, New York 14853). *Physical Review* [*Section*] *D: Particles and Fields;* **30**: No. 8, 1782-1790(15 Oct 1984). Contract AC03-76SF00098.

This work contains a brief review of known plaquette, string, and corner formulations on an infinite lattice, and reports the following new formulations: (1) invariant-plaquette formulation on the infinite lattice, (2) string, invariant-corner, and invariant-plaquette formulations on the finite lattice with periodic boundary conditions. On the finite lattice, new global Bianchi identities appear, conjugate to the new global dual variables, closely related to those of 't Hooft.

65 PHYSICS. II.

6510 Nuclear Physics

9242 (AAEC/PR—80-82, pp 65) **Progress report for Applied Physics Division 1 July 1981-30 June 1982.** Dec 1983. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780366.

In Divisional progress reports for period ending 30 June 1982.

The Division is organised as four sections: nuclear applications and energy studies; semiconductor and radiation physics; electronics systems; and fusion physics. Research activities include studies in neutron fission, neutron capture and neutron scattering; use of nuclear techniques of analysis such as PIXE; development of semiconductor detectors; tokamak experiments, and further fusion studies on MHD surface waves and alfven resonance heating of plasmas. A list of publications is included.

9243 **(AAEC/PR—80-82) Divisional progress reports for period ending 30 June 1982.** (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Dec 1983. 278p. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780366.

Individual sections of this report were input separately.

9244 **(DOE/ER/04660—T3) Very high energy nuclear physics. Final report.** Frankel, S. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). 31 Oct 1984. Contract AC02-78ER04660. 15p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85002892.

This final report covers work supported by the Medium Energy Physics Branch of the Department of Energy. A list of published experimental and theoretical papers arising from physics investigations at SREL, LAMPF, and FERMILAB is given, with brief summaries (22 entries). A similar list is given for experiments at the CERN ISR. The latter represent studies at ultrarelativistic energies, $E>>M$, with separate sections dealing with p-p (16 entries) and nuclear physics (13 entries). Comments on the significance of each paper are included. The experiments that were carried out in the 1983 CERN alpha-alpha run and their status are described.

9245 **(DOE/ER/04699—T1) Experiments on the TASS and HISS spectrometers at the Bevalac. Annual progress report, April 1, 1983-March 31, 1984.** Kirk, P.N. (Louisiana State Univ., Baton Rouge (USA). Dept. of Physics and Astronomy). 1983. Contract AS05-76ER04699. 164p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE84005145.

Achievements during the period from April 1, 1983 to March 31, 1984 by the intermediate energy nuclear physics group at Louisiana State University are discussed. These include: backward-forward proton correlation measurements, search for pionic instability, search for anomalous target fragments, and mid-rapidity pions in Ca-Ca collisions at 1.05 GeV. (GHT)

9246 **(DOE/ER/40015—3) Theoretical Nuclear Physics. Progress report, August 1, 1983-September 30, 1984.** Kunz, P.D.; Rost, E. (Colorado Univ., Boulder (USA). Nuclear Physics Lab.). Nov 1984. Contract AC02-81ER40015. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003466.

Progress is briefly described on the following projects: (1) microscopic relativistic nucleon-nucleus inelastic scattering; (2) nuclear currents and polarization-asymmetry differences in inelastic proton-nucleus scattering; (3) relativistic plane wave impulse approximation for proton-nucleus inelastic scattering; (4) Dirac Relativistic Impulse Approximation (DRIA) computer program; (5) relativistic treatment of exchange; (6) on the insensitivity of weak interaction amplitudes to relativistic nuclear dynamics; (7) Coulomb corrections in transfer reactions; (8) energy dependence of the $LI(p,d)^6Li$ reaction to the 1^+ and 3^+ states; and (9) Dirac formulation of the (p,γ) reaction. Publications are listed. (WHK)

9247 **(DOE/ER/40016—3) Intermediate energy nuclear physics (Task C) and charge exchange reactions (Task W). Progress report, October 1, 1983-September 30, 1984.** Kraushaar, J.J.; Peterson, R.J.; Ristinen, R.A.; Shepard, J.; Zafiratos, C. (Colorado Univ., Boulder (USA). Nuclear Physics Lab.). 1 Oct 1984. Contract AC02-81ER40016. 131p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85003465.

This report summarizes work carried out between October 1, 1983 and October 1, 1984 in the Nuclear Physics Laboratory in the Department of Physics at the University of Colorado, Boulder. The major part of the report describes work carried out under two separate contracts with the United States Department of Energy. The first contract supports the theoretical research program and the latter the work in experimental intermediate energy nuclear physics. The experimental research contract is divided into two separate tasks, C and W. Task C covers intermediate energy physics in general and Task W supports study of the (p,n) reaction at the WNR facility at LAMPF. In addition to the work supported by the described contracts, other efforts in the laboratory, such as LAMPF II accelerator development and several projects in low-energy nuclear physics, are described in this report.

9248 **(DOE/ER/40032—5) Nuclear structure at intermediate energies. Progress report, 1984-1985.** Phillips, G.C.; Mutchler, G.S. (Rice Univ., Houston, TX (USA). Bonner Nuclear Labs.). 21 Nov 1984. Contract AS05-81ER40032. 74p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85004348.

A substantial portion of the report period for the 1984-1985 contract year was spent in data taking for three experiments. Measurements were completed at Brookhaven on E-767, anti NP Annihilation Cross Sections Near anti NN Threshold. 1400 hours of beam time were received over approximately six months. LAMPF E-825, Investigation of the NΔ Interaction via $\pi^+ d \rightarrow p\pi^+ n$, was mounted and data taking was completed during August and September. Data taking was also completed on LAMPF E-708, Polarization Transfer in the Reaction p Vector $p \rightarrow p$ Vector $n\pi^+$ at 800 MeV.

9249 **(DOE/ER/40114—3) Theoretical aspects of electroweak and other interactions in medium-energy nuclear physics. Annual report, 1984.** Mukhopadhyay, N.C. (Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Physics). Nov 1984. Contract AC02-83ER40114. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003821.

The project under review had three distinct parts: (a) searches for new particles in nuclear physics, (b) theory of nuclear electroweak processes, and (c) atomic physics involving hyperfine interaction of muons with polarized and oriented nuclei. Maximum effort at RPI contered around item (b), while the collaborations with theorists outside RPI focussed on items (a) and (c) with come emphasis on (b). The progress made during the grant period in all these areas is discussed.

9250 **(GSI—84-1) GSI scientific report 1983.** (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Mar 1984. 451p. NTIS (US Sales Only), PC A20/MF A01. File Number TI85750474.

This annual report contains extended abstracts of the work performed in the named institute. These are concerning heavy ion reactions, nuclear structure studies, the discovery of new nuclides, the study of positron emission in atomic collisions, biological and physical radiation effects, developments in targets, radiation detectors, and counting electronics, performance of the UNILAC and future accelerator projects, as well as inertial confinement fusion.

9251 **(INIS-mf—9058) Annual report 1983 [Nuclear Physics Research Programs].** Van de Vyver, R.E. (ed.). (Ghent Rijksuniversiteit (Belgium). Lab. voor Kernfysica). 1983. 144p. NTIS (US Sales Only), PC A07/MF A01. File Number TI84703479.

In 1983, the various research projects in which the nuclear physics laboratory of Ghent State University is involved, were continued. In the present Annual Report, the results obtained in the field of photofission, photonuclear reactions positron annihilation, dosimetry and nuclear theory are summarized. The new 10 MeV high duty factor linear electron accelerator is presently being installed: performance tests will be carried out until July 1984; after which this facility will gradually become available for nuclear research purposes.

9252 **(INIS-mf—9466) Progress report 1983.** Chalupka, A.; Wild, E.; Dirniger, G. (eds.). (Oesterreichische Akademie der Wissenschaften, Vienna). 1984. 32p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85780367.

Separate entries were made in the data base for the sections in scope. (WHK)

9253 **Spin excitations in nuclei.** Petrovich, F.; Brown, G.E.; Garvey, G.T.; Goodman, C.D.; Lindgren, R.A.; Love, W.G. (eds.). New York, NY; Plenum Press (1984). 652p. (DOE/ER/40056—1; CONF-820357—). Plenum Publishing Corp., 233 Spring St., New York, NY 10013. File Number TI85002834. Contract FG05-82ER40056.

From International conference on spin excitations in nuclei; Telluride, CO, USA (25 Mar 1982).

Separate abstracts were prepared for the papers presented. (HK)

6512 Nuclear Properties And Reactions, A=1-5

REFER ALSO TO CITATION(S) 6512109254

9254 **(LA-UR—84-3518) Polarization in three-nucleon breakup: experiment and theory.** Brown, R.E.; Hardekopf, R.A.; Jarmie, N.; Correll, F.D.; Lambert, J.M.; Treado, P.A.; Slaus, I.; Schwandt, P.; Jacobs, W.W.; Meyer, H.O. (Los Alamos National Lab., NM (USA); Naval Academy, Annapolis, MD; Georgetown Univ., Washington, DC (USA); Institut Rudjer Boskovic, Zagreb (Yugoslavia); Indiana Univ., Bloomington (USA)). 1984. Contract W-7405-ENG-36. 14p. (CONF-841117—26). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003726.

From 8. conference on the application of accelerators in research and industry; Denton, TX, USA (12 Nov 1984).

A variety of analyzing powers for d+p breakup reactions initiated by polarized deuterons incident on protons have been measured at deuteron bombarding energies of 16 and 79 MeV. The results are compared with Faddeev calculations using both separable (at 16 and 79 MeV) and local (at 79 MeV) interactions. These calculations include nucleon-nucleon forces in the S, P, and D states and the $^3S_1$-$^3D_1$ tensor force. 19 references.

6513 Nuclear Properties And Reactions, A=6-19

9255 **(GSI—84-39(Prepr.)) Subthreshold pion production: Nucleon-nucleon single collisions vs. co-operative mechanisms.** Shyam, R.; Knoll, J. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Jun 1984. 38p. (CONF-8406207—1). NTIS (US Sales Only), PC A03/MF A01. File Number DE85750093.

From Workshop on coincident particle emission from continuum states (OPECOS '84); Bad Honnef, F.R. Germany (4 Jun 1984).

Various reaction mechanisms proposed to explain the pion production at "subthreshold" energies (below 290 MeV/A) are examined. They range from the nucleon-nucleon single collision mechanism to a co-operative multi-nucleon process. With a shell model prescription for the initial state energies the single collision picture can not explain the data. The participation of many nucleons in the pion production process appears to be necessary. We present a statistical model where the co-operative action of several of the target and projectile nucleons in the pion production process is invoked. We also consider the formation of the fragments in the final channel alongside the produced pion. Calculations performed within the model provide a good overall description of the experimental data over a wide range of beam energies and masses of the participating nuclei. Fragment formation in the final channel is seen to be vital to understand the experimental data within our model.

9256 **(LA-UR—84-3556) Theoretical calculations of the ^{6}Li(n,t) cross section.** Hale, G.M. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 19p. (CONF-8411118—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003731.

From Meeting on nuclear standard reference data; Geel, Belgium (12 Nov 1984).

The origin of the 1/v cross section for the ^{6}Li(n,t) reaction and the behavior of its angular distribution are discussed in the context of (1) conventional R-matrix analyses, (2) PWBA calculations of deuteron exchange, and (3) consistent R-matrix analyses. Results of a comprehensive, conventional R-matrix analysis or reactions in the ^{7}Li system are presented, and the possible interpretation of some of its parameters in terms of the deuteron exchange mechanism is discussed. An extension of the usual PWBA calculation to include internal bound-state effects in a simple model is shown to introduce additional poles into the T matrix and broaden the energy range over which particle exchange may be important. A consistent R-matrix treatment of the scattering equations in the internal and external regions leads to channel overlap terms that appear to include particle-exchange effects automatically with the resonances in an unitary fashion. 25 references, 10 figures.

6515 Nuclear Properties And Reactions, A=39-58

REFER ALSO TO CITATION(S) 6515109255, 9258

6517 Nuclear Properties And Reactions, A=90-149

9257 (INIS-mf—9466, pp 5) **Revised nuclear model calculations of neutron induced cross sections for ^{93}Nb.** Strohmaier, B. (Oesterreichische Akademie der Wissenschaften, Vienna. Inst. fuer Radiumforschung und Kernphysik). 1984. NTIS (US Sales Only), PC A03/MF A01. File Number DE85780367.

Published in summary form only.
In Progress report 1983.

9258 (INIS-mf—9466, pp 6) **Application of the direct reaction theory for continuum particle emission spectra to neutron induced reactions.** Uhl, M. (Oesterreichische Akademie der Wissenschaften, Vienna. Inst. fuer Radiumforschung und Kernphysik). 1984. NTIS (US Sales Only), PC A03/MF A01. File Number DE85780367.

Published in summary form only.
In Progress report 1983.

6518 Nuclear Properties And Reactions, A=150-189

REFER ALSO TO CITATION(S) 6518109261

6519 Nuclear Properties And Reactions, A=190-219

9259 **(GSI—84-40(Prepr.)) Pionic bremsstrahlung in heavy-ion collisions.** Vasak, D.; Greiner, W.; Mueller, B.; Stahl, T.; Uhlig, M. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Jul 1984. 14p. (CONF-8405179—5). NTIS (US Sales Only), PC A02/MF A01. File Number DE85750094.

From International conference on theoretical approaches to heavy ion reaction mechanisms; Paris, France (14 May 1984).

We apply the bremsstrahlung model for pion production to symmetric nuclear collisions at energies far below the single NN-threshold. All main features of recent neutral pion measurements can be explained by a single value of the deceleration parameter of the theory which is consistent with hydrodynamical calculations. Since the γ-ray bremsstrahlung also reflects the kinematics of its source, a simultaneous measurement of pion and γ-ray bremsstrahlung should be used to further test the collision dynamics. Results of our calculations for both kinds of radiation are presented. An extension of this approach to asymmetric systems is proposed.

6520 Nuclear Properties And Reactions, A=220 And Above

9260 **(EGG-M—24484) Actinide half-lives as standards for nuclear data measurements: current status.** Reich, C.W. (Idaho National Engineering Lab., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 15p. (CONF-8411118—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003255.

From Meeting on nuclear standard reference data; Geel, Belgium (12 Nov 1984).

The present status of knowledge of the half-life data for a number of long-lived actinide nuclides useful as standards for nuclear data measurements and reactor research and technology is summarized. The half-life information given draws heavily from the file of recommended decay data, generated over a number of years through the activities of an IAEA coordinated research program on the measurement and evaluation of transactinium-isotope nuclear decay data, whose work has recently been completed.

9261 **(UCRL—90686) Applications of level structure modeling of odd-odd deformed nuclei.** Hoff, R.W.; Gardner, D.G.; Gardner, M.A.; Kern, J.; Piepenbring, R.; Boisson, J.P.; Casten, R.F.; Bergoffen, M.; Warner, D.D. (Lawrence Livermore National Lab., CA (USA); Fribourg Univ. (Switzerland). Inst. de Physique; Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires; Brookhaven National Lab., Upton, NY (USA)). 4 Dec 1984. Contract W-7405-ENG-48. 22p. (CONF-841210—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004421.

From International chemical congress of Pacific Basin Societies; Honolulu, HI, USA (16 Dec 1984).

A phenomenological model, for which input data are empirical excitations and rotational parameters from neighboring nuclei, has been demonstrated to effectively reproduce level structure in odd-odd deformed nuclei. Applications have been made to actinide nuclei for interpretation of experimental data from (n,gamma) and transfer reaction studies (238Np, 244Am, 250Bk), from beta decay of even-even nuclides (242Np, 246Am), and from alpha decay (248Bk, 250Bk). Implications of modeled levels (174Lu, 176Lu, 236Np, 242Am) for formulation of level densities and calculation of neutron reaction cross sections will be discussed. 24 references, 7 figures.

6530 Nuclear Theory

REFER ALSO TO CITATION(S) 6530009200, 9201, 9246

9262 **(DOE/ER/10419—T2) Research in theoretical nuclear physics. Progress report, March 1, 1984-February 28, 1985.** Robson, D. (Florida State Univ., Tallahassee (USA)). 1984. Contract AS05-79ER10419. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004349.

Our drive to describe multi-hadron systems in terms of quark-gluon dynamics has continued in the past year with the emphasis being on studying models which are motivated by the underlying symmetries of QCD. We are concerned with three major symmetries: Lorentz covariance, local SU(3) color gauge invariance and chiral invariance. A large fraction of quark models of hadrons do not incorporate any of these symmetries and in many cases such models produce unphysical predictions, e.g., color Van der Waal's interactions, discontinuous axial vector currents, divergent self energies, etc. Since it does not appear possible as yet to include all the desired ingredients of QCD we have been studying models which incorporate some of the major consequences of the underlying QCD theory. In the past year there have been two major areas of study which are discussed: nucleon-nucleon systems and relativistic equations.

9263 **(GSI—84-38(Prepr.)) Nuclear matter bulk density in the droplet and Hartree-Fock models.** Berdichevsky, D.; Tondeur, F. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Jun 1984. 56p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85750091.

The predictions of the droplet (DM) and Hartree-Fock (HF) models for the nuclear matter density in the bulk region of finite nuclei are compared with experimental data. It is shown that the standard DM systematically underestimates the matter density in finite nuclei, this being mainly due to a bad fit of its parameters. The crucial role of the diffuseness and redistribution corrections to the DM is emphasised. These corrections strongly improve the agreement between HF and DM predictions when consistent sets of parameters are used. The systematic study of HF results also reveals deficiencies in the parametrisation of many HF effective interactions. For Skyrme-type forces of the standard form, with a reasonable compression modulus, we propose an improved estimation of the infinite nuclear matter saturation density, which is evaluated to 0.162 fm^{-3} +- 2%, i.e. ksub(F) = 1.34 fm^{-1}.

9264 **(GSI—84-41(Prepr.)) Unified model of dilute and superdense finite nuclear systems.** Biro, T.S.; Bondorf, J.P. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Jul 1984. 21p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85750092.

We constructed a microscopical transport model for the description of the evolution of density fluctuations in finite nuclei. We found, however, two stationary solution of the problem: a dilute and a very dense one. Investigating the thermodynamical limit of the model a first order phase transition between dilute and superdense phases was found. Relations to nuclear matter - quark matter phase transition predictions are discussed. Further results on finite size effects, relaxation and compression-expansion phenomena are briefly mentioned.

9265 **(IC—83/170) Lower bound and estimates for resonances.** Sidharth, B.G. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1983. 8p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700188.

Using Schwinger's variational formula for the phase shifts, we deduce a lower bound for the potential strength lambdasub(l)(K) at which deltasub(l)(K)=π/2. The derivation is used to show that the lower bound is a worse estimate than a known upper bound. Whence an improved lower bound is deduced which is then used to obtain an estimate for lambdasub(l)(K). These considerations are then illustrated for some potentials of practical interest, viz., the square well, exponential, Morse and Yukawa, the results being satisfactory.

9266 (INIS-mf—9078, pp 59-78) **Nuclear level densities and partition functions.** Engelbrecht, C.A.; Joubert, D.P. (Stellenbosch Univ. (South Africa). Dept. of Physics). 1984. NTIS (US Sales Only), PC A18/MF A01. File Number TI85780085. (CONF-8207113—; CONF-8307139—).

From 17. annual seminar on theoretical physics; Stellenbosch, South Africa (13 Jul 1982).

The partition function for a composite system consists of a 'bound state' and a continuum contribution. It is argued that the continuum contribution should in many applications of the partition function be excluded. The bound state contributionn can be calculated by means of a truncated fermi gas model, where the single particle spectrum is truncated at a point where single nucleon phase shifts no longer show bound state or resonance behaviour. The calculation of level densities and partition fuctions using this method is based on a practical algorithm for solving a difficult combinatorial problem.

9267 (INIS-mf—9078, pp 375-390) **Giant multipole resonances in nuclei.** De Kock, P.R. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Accelerator Centre). 1984. (In Afrikaans). NTIS (US Sales Only), PC A18/MF A01. File Number TI85780085. (CONF-8307139—; CONF-8207113—).

From 18. annual seminar on theoretical physics; Pretoria, South Africa (11 Jul 1983).

A review of giant multipole resonances is presented, with the emphasis on the basic understanding of this phenomenon in general. Aspects of the earlier hydrodynamic models and the later microscopic models in terms of particle-hole excitations are discussed. Finally some aspects of the description of resonance widths and fine structure are dealt with.

9268 (INIS-mf—9078, pp 363-373) **Random Phase Approximation (RPA) studies in nuclei near closed shells.** Hoffman, M.J.H. (Nuclear Development Corp. of South Africa (Pty.) Ltd., Pelindaba, Pretoria); De Kock, P.R. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Accelerator Centre). 1984. (In Afrikaans). NTIS (US Sales Only), PC A18/MF A01. File Number TI85780085. (CONF-8307139—; CONF-8207113—).

From 18. annual seminar on theoretical physics; Pretoria, South Africa (11 Jul 1983).

The relationship between the theories of the Random Phase Approximation (RPA) and the Finite Fermi Systems (FFS) will be outlined. A formalism which has been used in the application of these theories will be discussed and finally some results of calculations in A plus minus 1 nuclei (A = closed shell nucleon number) are presented.

9269 (INIS-mf—9078, pp 317-335) **Giant dipole resonance in the interacting boson-model.** Scholtz, F.G. 1984. (In Afrikaans). NTIS (US Sales Only), PC A18/MF A01. File Number TI85780085. (CONF-8307139—; CONF-8207113—).

From 18. annual seminar on theoretical physics; Pretoria, South Africa (11 Jul 1983).

Dipole states, represented by a p-boson, are introduced into the interacting boson-model (IBM). In the SU(3)-limit of IBM the interactions between the p-boson and s- and d-bosons split the giant dipole resonances in two parts. The Raman scattering to the side bands tends to be very small. This is in agreement with recent measurements on Er.

9270 (INIS-mf—9078, pp 79-95) **Toward realistic shell model calculations in larger model spaces.** Miller, H.G. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Research Inst. for Mathematical Sciences). 1984. NTIS (US Sales Only), PC A18/MF A01. File Number TI85780085. (CONF-8207113—; CONF-8307139—).

From 17. annual seminar on theoretical physics; Stellenbosch, South Africa (13 Jul 1982).

A general method for obtaining the lower-lying eigenstates of an effective Hamiltonian via configuration-mixing calculations with basis states generated systematically from variational methods is presented. Since only a relatively small number of such basis states is required, nuclear structure calculations in larger model spaces are tractable.

9271 (INIS-mf—9078, pp 97-108) **Selected topics in few-body problems.** Eyre, D. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Research Inst. for Mathematical Sciences). 1984. NTIS (US Sales Only), PC A18/MF A01. File Number TI85780085. (CONF-8307139—; CONF-8207113—).

From 18. annual seminar on theoretical physics; Pretoria, South Africa (11 Jul 1983).

The aim of this survey talk is to present some recent developments in the application of few-body problems. Several representative examples are taken from areas of nuclear and atomic physics.

9272 (INIS-mf—9466, pp 5) **Neutron optical potentials in the A approximately 50 mass region.** Strohmaier, B. (Oesterreichische Akademie der Wissenschaften, Vienna. Inst. fuer Radiumforschung und Kernphysik). 1984. NTIS (US Sales Only), PC A03/MF A01. File Number DE85780367.

Published in summary form only.

In Progress report 1983.

9273 **(KFK—3646) Critical review of precompound models with consideration of the contribution to the 'international nuclear model and code comparison on pre-equilibrium effects', organized by the NEA Data Bank 1983/84.** Jahn, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik). Aug 1984. 41p. NTIS (US Sales Only), PC A03/MF A01. File Number TI85750479.

It is shown that the desired predictive capability of most of the commonly used precompound formalisms to calculate nuclear reaction cross-sections is seriously reduced by too much arbitrariness of the choice of parameters. The origin of this arbitrariness is analyzed in detail and improvements and alternatives are discussed.

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 6540009242

9274 **(BNL—19302-Vol.2) Cross Section Evaluation Group shielding benchmark compilation. Volume II.** Rose, P.F.; Roussin, R.W. (Brookhaven National Lab., Upton, NY (USA)). Dec 1983. Contract AC02-76CH00016. 60p. (ENDF—202). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85003919.

At the time of the release of ENDF/B-IV in 1974, the Shielding Subcommittee had identified a series of 12 shielding data testing benchmarks (the SDT series). Most were used in the ENDF/B-IV data testing effort. A new concept and series was begun in the interim, the so-called Shielding Benchmark (SB) series. An effort was made to upgrade the SDT series as far as possible and to add new SB benchmarks. In order to be designated in the SB class, both an experiment and analysis must have been performed. The current recommended benchmark for Shielding Data Testing are listed. Until recently, the philosophy has been to include only citations to published references for shielding benchmarks. It is now our intention to provide adequate information in this volume for proper analysis of any new benchmarks added to the collection. These compilations appear in Section II, with the SB5 Fusion Reactor Shielding Benchmark as the first entry.

9275 (INIS-SU—252, pp 36-40) **Definition by the backscattering method of fast H^+ and He^+ ions the concentration profiles of impurity atoms in multicomponent samples with account of interstitial contribution to ion slowing down.** Grazhdankin, V.N.; Shipatov, Eh.T. (Rostovskij-na-Donu Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Inst. Fiziki). 1983. (In Russian). NTIS (US Sales Only), PC A06/MF A01. File Number TI85780019.

In Radiation damage physics and radiation technology.

A method of energy spectra of backscattered fast H^+ and He^+ ion treatment is offered. It allows to divide the indiscrete yields of ion scattering of any-kin atoms of multicomponent sample, to define atom concentration ratio of various components and atom depth distribution. The method is based on Bragg rule for backscattered possibilities of multicomponent target. By this means the backscattered He^+ ion spectra with 1.4 MeV at 16a deg angle in crystalline silicon coated by SiO_2 film was treated. Phosphorus and germanium atoms were implanted by thermodiffusion into crystalline silicon. It is shown that the film stoichiometry significantly differs from SiO_2 stoichiometry.

9276 **(INP—1180/PH) Solution of the thermal neutron diffusion equation for a two-region cyclindrical system program for ODRA-1305 computer.** Drozdowicz, K.; Woznicka, U. (Institute of Nuclear Physics, Krakow (Poland)). 1982. 32p. NTIS (US Sales Only), PC A03/MF A01. File Number TI84703477.

ODRA-1305 computer, FORTRAN 1900 (a version of FORTRAN 4).

The program in FORTRAN for the ODRA-1305 computer is described. The dependence of the decay constant of the thermal neutron flux upon the dimensions of the two-region concentric cylindrical system is the result of the program. The solution (with a constant neutron flux in the inner medium assumed) is generally obtained in the one-group diffusion approximation by the method of the perturbation calculation. However, the energy distribution of the thermal neutron flux and the diffusion cooling are taken into account. The program is written for the case when the outer medium is hydrogenous. The listing of the program and an example of calculation results are included.

6550 Medical Physics

REFER ALSO TO CITATION(S) 6550008433, 8434, 8999, 9012, 9037

9277 (FNAL-TM—1108) Characteristics of A-150 plastic-equivalent gas in A-150 plastic ionization chambers for p(66)Be(49) neutrons. Awschalom, M.; Rosenberg, I.; Ten Haken, R.K.; Pearson, D.W.; Attix, F.H.; DeLuca, P.M. (Fermi National Accelerator Lab., Batavia, IL (USA); Wisconsin Univ., Madison (USA). Dept. of Medical Physics). 8 Jul 1982. Contract AC02-76CH03000. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003766.

The evaluation of a gas mixture having an atomic composition similar to that of A-150 TE-plastic has been extended to a high energy neutron therapy beam. A-150 gas, air and methane-based TE gas were each flowed through A-150 plastic-walled ion chambers of different sizes and irradiated with p(66)Be(49) neutrons. A tentative value for anti W(A-150) of 27.3 +- 0.5 J C^{-1} was derived for this beam. The anti W value of the A-150 gas mixture is compared to those of methane-based TE gas and of air for the p(66)Be(49) neutron beam as well as to corresponding values found in similar experiments using 14.8 MeV monoenergetic neutrons. 17 references, 3 figures, 3 tables.

9278 (FNAL-TM—1152) New look at displacement factor and point of measurement corrections in ionization chamber dosimetry. Awschalom, M.; Rosenberg, I.; Ten Haken, R.K. (Fermi National Accelerator Lab., Batavia, IL (USA)). Jan 1983. Contract AC02-76CH03000. 34p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85004276.

A new technique is presented for determination of the effective point of measurement when cavity ionization chambers are used to measure the absorbed dose due to ionizing radiation in a dense medium. An algorithm is derived relating the effective point of measurement to the displacement correction factor. This algorithm relates variations of the displacement factor to the radiation field gradient. The technique is applied to derive the magnitudes of the corrections for several chambers in a p(66)Be(49) neutron therapy beam. 30 references, 4 figures, 1 table.

9279 (FNAL-TM—1221-A) About phanta for clinical neutron dosimetry. Awschalom, M. (Fermi National Accelerator Lab., Batavia, IL (USA)). 29 Nov 1983. Contract AC02-76CH03000. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004250.

The selection of a muscle tissue equivalent solution with a density of 1.04 g/cm^3 for phanta is argued for. 4 references. (ACR)

9280 (PB—85-102143) Programme of the United States Bureau of Standards in dosimetry standards for neutron radiation therapy. Final report. Goodman, L.J.; Coyne, J.J.; Caswell, R.S. (National Bureau of Standards, Washington, DC (USA)). 1984. 11p. Pub. in Proceedings in Advances in Dosimetry for Fast Neutrons and Heavy Charged Particles for Therapy Applications, Vienna, Austria, June 14-18, 1982, IAEA-AG-371/8, p. 217-227, 1984.

This report discusses two aspects of the neutron dosimetry program at the United States National Bureau of Standards (NBS), namely the plans and progress towards establishing dosimetry standards for neutron radiation therapy, and an investigation of the neutron and gamma-ray tissue kerma rates from a ^{252}Cf source. Neutron radiation therapy is being clinically tested at a number of centers in the world. To maximize the chances of success of this radiation therapy modality, good physical dosimetry is needed. To facilitate exchange of therapy experience between institutions, the United States dosimetry standards base must be accurate and consistent with the international standards system. The purpose of the NBS program is to improve the accuracy and consistency of measurements of absorbed dose for neutron radiation therapy by providing national dosimetry standards and improved data on neutron interactions with tissue and tissue-equivalent materials. A longer-term goal is to develop a calibration facility at NBS where neutron dosimeters can be calibrated and their energy dependence studied.

6560 Solid State Physics

REFER ALSO TO CITATION(S) 6560008805

9281 (DOE/ER/45059—1) Multilayer film growth on silver using Surface Plasmon Resonance. Progress report. Bretz, M. (Michigan Univ., Ann Arbor (USA). Dept. of Physics). 26 Nov 1984. Contract FG02-84ER45059. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85004300.

During the first 7 months of this two year Surface Plasmon Resonance project we have made considerable progress. We confirmed the presence of an anomalously large plasmon scattering mechanism when 100A xenon films are adsorbed onto a silver surface at 60°K. This anomaly and its relation to surface roughness was reported at the APS March Meeting. The anomaly's dependence on temperature and film thickness will be carefully investigated this year. But first, we wanted to improve thermal stability by replacing our glass SPR coupling prism with a sapphire one and by remounting the prism to the cold tip refrigerator. During this time the apparatus was moved to a larger and more appropriate laboratory space and the vacuum system was completely rebuilt. The doubly trapped diffusion pump system and optical chamber were replaced with a large ultra-high vacuum chamber and vacion pump. Our system is now reassembled and presently operative in the 6 x 10^{-10} Torr range.

9282 (IC—83/98) Conductivity of the electron-impurity system. Goettig, S. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1983. 25p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700221.

The free-carrier absorption of electromagnetic radiation due to the presence of static scatterers is examined taking into account the electron-electron interaction, the plasma-phonon polar coupling and the plasma anisotropy. For the case of strong coupling in the isotropic plasma the absorption due to the collective-mode excitation processes is, for frequencies just above the plasmon-like collective mode frequency, shown to be dominant over the absorption due to single-particle excitations. The expression for the frequency-dependent absorptive part of the conductivity due to the long-wavelength collective-mode excitations is derived for the case of multicomponent anisotropic degenerate plasma (e.g. lead chalcogenides). The results are discussed in detail and compared with available experimental data for n-PbSe. The comparison with the previous theories is also given.

9283 (IC—83/112) Diffusion on a disordered Cayley tree. Brezini, A.; Olivier, G. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1983. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700214.

The model proposed recently by Brezini to calculate the average probability and the average size of the localization domain for an electron being localized at a given site in a disordered Cayley tree, is extended to the case of a uniform distribution for site energies. Thus, numerical results are presented in the limit of weak disorder and particular attention is paid to the states near the mobility edge.

9284 (IC—83/168) Solitary clusters consisting of magnons and phonons. Pushkarov, Kh.I.; Primatarowa, M.T. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1983. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700215.

An anisotropic Heisenberg ferromagnetic chain is considered when the lattice deformation caused by the spin deviations is taken into account. The possibility of solitary bound formation between spin clusters and lattice deformation is investigated. It is shown that such a solitary "domain" can exist and propagate along the chain with constant velocity and without "smearing". In this way magnetic moment can be transferred without dissipation.

9285 **(IC—83/169) Effect of thermal oscillations of molecules on the properties of solitons in one-dimensional molecular lattices.** Stoianova, I.S. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1983. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700207.

A quantum mechanical treatment of the collective excitations in one-dimensional molecular chains is presented and the influence of thermal oscillations on the properties of solitary excitations is taken into account. The general case of exciton-phonon interaction is considered and the soliton state is found as a solution of a nonlinear Schroedinger equation with nonlinearities of third and fifth order.

9286 **(IC—83/171) Effective Hamiltonian for 2-dimensional arbitrary spin Ising model.** Sznajd, J. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1983. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700219.

The method of the reduction of the generalized arbitrary-spin 2-dimensional Ising model to spin-half Ising model is presented. The method is demonstrated in detail by calculating the effective interaction constants to the third order in cumulant expansion for the triangular spin-1 Ising model (the Blume-Emery-Griffiths model).

9287 **(IC—83/192) Renormalization group decimation technique for disordered binary harmonic chains.** Wiecko, C.; Roman, E. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1983. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700190.

The density of states of disordered binary harmonic chains is calculated using the Renormalization Group Decimation technique on the displacements of the masses from their equilibrium positions. The results are compared with numerical simulation data and with those obtained with the current method of Goncalves da Silva and Koiller. The advantage of our procedure over other methods is discussed.

9288 **(IC—83/232) Note on macroscopic quantum tunnelling with dissipation.** Jayannavar, A.M. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1983. 5p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700191.

It is shown that dissipation decreases the quantum tunnelling amplitude. Our treatment is based on frictional Hamiltonian methods. A result similar to that of Caldeira and Leggett has been obtained in an appropriate limit.

9289 (INIS-mf—9078, pp 163-172) **Teaching the renormalization group.** Gering, M.Z.I. (University of the Witwatersrand, Johannesburg (South Africa). Dept. of Physics). 1984. NTIS (US Sales Only), PC A18/MF A01. File Number TI85780085. (CONF-8307139—; CONF-8207113—).

From 18. annual seminar on theoretical physics; Pretoria, South Africa (11 Jul 1983).

The renormalization group theory of continuous phase transitions is described with the use of a hands on model suitable for presentation as part of an undergraduate thermal physics course. It is an extension of the work of Maris and Kadanoff in that key concepts such as universality fixed points and critical surface are introduced.

9290 **Optimization of the experimental resolution for small-angle scattering.** Mildner, D.F.R. (Missouri Univ., Columbia (USA). Research Reactor Facility); Carpenter, J.M. (Argonne National Lab., IL (USA)). *Journal of Applied Crystallography;* **17**: No. 4, 249-256(1 Aug 1984).

The instrumental optimization conditions for most small-angle scattering experiments in which the data are azimuthally symmetric require that the scattered flight path be equal to the incident flight path. This is in contrast to a recent analysis which shows that under some conditions the incident and scattered flight paths are in a ratio of two to one. The equal flight-path condition is also valid for experiments measuring sharp (Bragg-like) peaks, or where the intensity is required at specific scattering vectors, as in low-angle diffraction of ordered or semiordered systems. The implications of the optimization conditions on the resolution and count rates at the detector are discussed for both types of experiment, and the dependence of the resolution on the spectrometer geometry is considered.

6561 Superconductivity

REFER ALSO TO CITATION(S) 6561008803, 8816, 8837, 8845, 8858, 8868

9291 **(IC—83/115) Pinning of a curved flux line by macroscopic inclusions in a type II superconductor.** Shehata, L.N.; Saif, A.G. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1983. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700244.

The pinning force is calculated as a function of the distance between a curved (or straight) flux line and the centre of a macroscopic superconducting (or normal) ellipsoidal inclusion. When the ellipsoidal tends to a spherical inclusion the results agree with those previously obtained.

9292 **(IC—83/162) Renormalization-group decimation technique for spectra, wave-functions and density of states.** Wiecko, C.; Roman, E. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1983. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700245.

The Renormalization Group decimation technique is very useful for problems described by 1-d nearest neighbour tight-binding model with or without translational invariance. We show how spectra, wave-functions and density of states can be calculated with little numerical work from the renormalized coefficients upon iteration. The results of this new procedure are verified using the model of Soukoulis and Economou.

9293 **(LBL—18324) Thermoelectric charge imbalance in superconducting aluminum and the development of a scanning tunneling microscope.** Mamin, H.J. (Lawrence Berkeley Lab., CA (USA)). Oct 1984. Contract AC03-76SF00098. 133p. NTIS, PC A07/MF A01; GPO Dep. File Number DE85004108.

Thesis.

Two experiments in solid-state physics have been performed, the observation of the superconducting fountain effect and the development of a Scanning Tunneling Microscope. In the first experiment, the quasiparticle transport current induced in a superconducting aluminum film by a temperature gradient has been measured by means of the spatially decaying charge imbalance generated near the end of the sample, where the current is divergent. The magnitude and decay length of the charge imbalance are in good agreement with the predictions of a simple model that takes into account the nonuniformity of the temperature gradient. The inferred value of the thermopower in the superconducting state agrees reasonably well with the value measured in the normal state. Measurements of the decay length of the charge imbalance induced by current injection yield a value of the inelastic relaxation time tau/sub E/ of about 2 ns, which is substantially smaller than that obtained from other measurements for reasons which are not completely understood. In the second experiment, a Scanning Tunneling Microscope, an instrument first developed at IBM Zurich, has been developed at U.C. Berkeley in order to study surface structure. On uncleaned gold surfaces, a typical vertical resolution of 0.1 A and a lateral resolution of 20 to 30 A have been achieved, with one instance of lateral resolution under 10 A. 85 references, 36 figures.

6570 Theoretical Physics

REFER ALSO TO CITATION(S) 6570009131, 9147, 9215, 9216, 9217, 9218, 9219, 9234, 9235, 9265, 9287, 9288, 9289, 9304

9294 **(IC—83/233) Finite difference evolution equations and quantum dynamical semigroups.** Ghirardi, G.C.; Weber, T. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1983. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700192.

We consider the recently proposed [Bonifacio, Lett. Nuovo Cimento, 37, 481 (1983)] coarse grained description of time evolution for the density operator rho(t) through a finite difference equation with steps tau, and we prove that there exists a generator of the quantum dynamical semigroup type yielding an equation giving a continuous evolution coinciding at all time steps with the one induced by the coarse grained description. The map rho(0)→rho(t) derived in this way takes the standard form originally proposed by Lindblad [Comm. Math. Phys., 48, 119 (1976)], even when the map itself (and, therefore, the corresponding generator) is not bounded.

9295 (INIS-mf—9078, pp 1-47) **New uncertainty relation for angular momentum and angle.** Kranold, H.U. (Nuclear Development Corp. of South Africa (Pty.) Ltd., Pelindaba, Pretoria). 1984. NTIS (US Sales Only), PC A18/MF A01. File Number TI85780085. (CONF-8207113—; CONF-8307139—).

From 17. annual seminar on theoretical physics; Stellenbosch, South Africa (13 Jul 1982).

An uncertainty relation of the form $\Delta L_a \Delta So >= \sup(h/2\pi)/\sub(2)$ is derived for angular momentum and angle. The non-linear operator So measures angles and has a simple interpretation. Subject to very general conditions of rotational invariance the above relation is unique. Radial momentum is not quantized.

9296 (INIS-mf—9078, pp 289-316) **Seniority and physical bosons.** Geyer, H.B. 1984. (In Afrikaans). NTIS (US Sales Only), PC A18/MF A01. File Number TI85780085. (CONF-8307139—; CONF-8207113—).

From 18. annual seminar on theoretical physics; Pretoria, South Africa (11 Jul 1983).

Seniority is shown to provide a guiding principle in the construction of physical bosons. Within the framework of a single j-shell physical boson operators are constructed using the Dyson mapping.

9297 (INIS-mf—9078, pp 49-58) **Note on the radial component of momentum.** Kranold, H.U. (Nuclear Development Corp. of South Africa (Pty.) Ltd., Pelindaba, Pretoria). 1984. NTIS (US Sales Only), PC A18/MF A01. File Number TI85780085. (CONF-8207113—; CONF-8307139—).

From 17. annual seminar on theoretical physics; Stellenbosch, South Africa (13 Jul 1982).

Operators have been proposed to correspond to radial momentum. These turn out to be of purely formal significance. By prescribing most general symmetry properties, it is shown that radial momentum cannot be a quantum mechanical observable.

9298 (INIS-mf—9078, pp 391-393) **Phase II non-locality experiments.** Bedford, D. (Natal Univ., Durban (South Africa). Dept. of Physics); Wang, D. (Natal Univ., Durban (South Africa). Dept. of Building Science). 1984. NTIS (US Sales Only), PC A18/MF A01. File Number TI85780085. (CONF-8307139—; CONF-8207113—).

From 18. annual seminar on theoretical physics; Pretoria, South Africa (11 Jul 1983).

9299 **(INIS-mf—9078) 17. and 18. Annual seminar on theoretical physics, Stellenbosch, 13-15 Jul 1982, Pretoria, 11-15 Jul 1983.** (Organization of Theoretical Physicists, Pretoria (South Africa); South African Inst. of Physics, Faure. Subgroup for Theoretical Physics). 1984. 403p. (CONF-8207113—; CONF-8307139—). NTIS (US Sales Only), PC A18/MF A01. File Number TI85780085.

From 17. annual seminar on theoretical physics; Stellenbosch, South Africa (13 Jul 1982).

Separate abstracts are presented for each of the papers on theoretical physics included in the data base.

9300 (LBL—18500, pp 54-56) **Center for X-Ray Optics.** Aug 1984. NTIS, PC A04/MF A01. File Number DE85003166.

In Accelerator and Fusion Research Division: summary of activities, 1983.

The Center for X-Ray Optics was created in response to the growing need for new optical components and techiques applicable to the xuv region of the electromagnetic spectrum. It has already organized collaborations to develop and use a broad range of new technologies, and experimental and theoretical work has begun on mirrors, gratings, and detectors; on multilayer optical coatings; and on freestanding microstructures to be used as diffractive elements for x-ray focusing and imaging. An especially exciting prospect for the future is the demonstration of x-ray microholography using tunable coherent radiation.

9301 (NP—5770042) **Contribution to the theory of optimum volume flow rates of heavily loaded wind turbines.** Weber, W. (Stuttgart Univ. (Germany, F.R.)). 23 Jan 1981. 101p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number TI85770042.

The dissertation treats the problem of optimum volume flow rates and the resulting wind turbine characteristics at different loads. The performance factor is calculated up to high loads by applying elements of the theory of heavily loaded free-running propellers to the operating conditions of the wind turbine. An interdependence between slipstream reduction, tip speed ratio and slipstream expansion was found and verified by applying Biot-Savart's induction laws to a simple swirl-flow model. However, when the consequences of the new theory for the calculations of total performance factors of real wind rotors were analyzed, the new findings were found to have little influence on the value of the integral performance factors.

6580 Mathematical Physics

9302 (IC—83/229) **Projective representations of finite Abelian groups.** Saeed-ul-Islam, M. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1983. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700186.

We determine complete sets of inequivalent irreducible projective representations of Csub(m)sup(n)=(wsub(l)...wsub(n); wsub(i)sup(m)=1, i=1,...,n; wsub(i)wsub(j)=wsub(j)wsub(i),i,j=1,...,n) with respect to a class of factor sets α, where α (wsub(i),wsub(j))=theta, for i,j=1,...,n and theta is a fixed m-th root of unity. We construct a single irreducible projective representation of Csub(m)sup(n) for each factor set α and call it the basic projective representation. The rest of the representations is obtained by tensoring the basic projective representations with some ordinary representations of Csub(m)sup(n). Projective representations of Csub(m)sup(n) are thus parametrized in terms of its ordinary representations.

9303 (IC—83/231) **Computational note on finite groups with two generators.** Saeed-ul-Islam, M. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1983. 5p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700187.

Finite groups with two independent generators attracted the attention of mathematicians during 1940-1959. These groups are subgroups of SU(n) and an interest is now being shown in these groups by particle physicists. In this note we give a brief history of these groups and announce some of the computations done by using a computer.

9304 (IC—83/236) **Path integrals over SU(2) manifold and related potentials.** Duru, I.H. (International Centre for Theoretical Physics, Trieste (Italy)). Feb 1984. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700193.

A path integral formalism is developed on the SU(2) manifold parametrized in terms of the Euler angles. The Green's function is studied for the Poeschl-Teller potential and the corresponding wave functions and energy spectrum are obtained.

9305 **(LA-UR—84-3522) Low-dimensional behavior of the pattern formation Cahn-Hilliard equation.** Nicolaenko, B.; Scheurer, B. (Los Alamos National Lab., NM (USA); CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France); Paris-11 Univ., 91 - Orsay (France)). 1984. Contract W-7405-ENG-36. 15p. (CONF-8406225—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003727.

From 6. international conference on trends in the theory and practice of nonlinear analysis; Dallas, TX, USA (18 Jun 1984).

We investigate the fourth-order Cahn-Hilliard parabolic partial differential equation which describes pattern formation in phase transition. Neumann and periodic boundary conditions are considered for a domain in R/sup n/, $1 \leqq n \leqq 3$. This equation is characterized by a negative (backward) second order diffusion and multiple steady states for the appropriate range of parameters. We establish compactness of the orbits in $H^1(\Omega)$ and convergence to some steady state. We demonstrate that the Cahn-Hilliard equation admits an intrinsic low dimensional behavior: in R^1, the number of determining modes (in a Galerkin expansion) is proportional to L/sup 3/2/; where L, the diameter of the domain, is also proportional to the number of unstable modes for the linearized equation. Similar results hold for $n = 2,3$.

70 FUSION ENERGY

9306 **(PB—84-234327) Implosion hydrodynamics.** Evans, R.G. (Rutherford Appleton Lab., Chilton (UK)). 1984. 80p. (RAL—84-058). NTIS, PC E05/MF E05.

In this chapter we show how various constraints arise on the initial target configuration and the driver performance. A short description of the thermonculear reactions of Deutrium and Tritium will show how the temperature in the implosion core is determined and this in turn determines the implosion velocity. A simple calculation of the thermonuclear 'burn' processes will show how the total fuel mass and imploded density are constrained and this in turn controls the kinetic pressure in the implosion core. The hydrodynamic properties of the imploding shell are then considered and the pressure amplification in the implosion together with the final pressure serve to determine the pressure produced by the driver. A simplified analytical model of the target heating by the driver shows how to calculate the power density needed to generate this drive pressure. The combination of all these quantities yields the target radius, the implosion time and the total power and energy requirements of the driver. Finally we will give an outline of the major problems in predicting target performance, the uncertainties in symmetry and hydrodynamic stability of the imploding material, and describe some of the outline target designs which have been proposed.

7001 Plasma Research

REFER ALSO TO CITATION(S) 7001009242, 9362

9307 **(CONF-8411121—1) MHD activity in high-β currentless plasmas in Heliotron-E.** Harris, J.H.; Motojima, O.; Kaneko, H.; Besshou, S.; Zushi, H.; Wakatani, M.; Sano, F.; Sudo, S.; Sasaki, A.; Kondo, K. (Oak Ridge National Lab., TN (USA); Kyoto Univ. (Japan)). Nov 1984. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003681.

From US/USSR atomic energy agreement for scientific and technical cooperation for peaceful usage meeting; Moscow, USSR (12 Nov 1984).

9308 **(CONF-8411121—2) ATF physics design.** Harris, J.H. (Oak Ridge National Lab., TN (USA)). Nov 1984. Contract AC05-84OR21400. 52p. NTIS, PC A04. File Number TI85003341.

From US/USSR atomic energy agreement for scientific and technical cooperation for peaceful usage meeting; Moscow, USSR (12 Nov 1984).

9309 **(IPP—1/225) Active phase double crystal monochromator for JET (diagnostic system KS1).** Andelfinger, C.; Fink, J.; Fussmann, G.; Krause, H.; Roehr, H.; Schilling, H.B.; Schumacher, U.; Becker, P.; Siegert, H.; Abel, P. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Mar 1984. 96p. NTIS (US Sales Only), PC A05/MF A01. File Number DE85750105.

The determination of the impurity concentrations in JET plasmas by absolute radiation measurements in a wide spectral range can be done with a double crystal monochromator device in parallel mode, which is able to operate during all experimental phases of JET. The report describes the engineering design and tests for a double crystal monochromator that fulfills the conditions of parallel orientation of the two crystals during fast wavelength scan, of shielding against neutrons and gamma rays by its folded optical pathway and of sufficient spectral resolution for line profile measurements.

9310 **(IPP—4/211) Mode-conversion and tunneling at the two-ion hybrid and ion cyclotron resonances.** Ottaviani, M. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Jul 1983. 34p. NTIS (US Sales Only), PC A03/MF A01. File Number TI85750469.

This report is devoted to the propagation of electromagnetic waves in the I.C. frequency range and is intended to complete a work by M. Brambilla and the present author. In addition to a derivation of the coupling equations, we present an evaluation of the coupling coefficients in many of the current I.C. heating scenarios.

9311 **(IPP—6/233) Effect of parallel ion motion in three-drift-wave interaction.** Kaifen, H.; Biskamp, D. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Mar 1984. 56p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85750100.

The nonlinear interaction of three drift modes, including parallel ion motion, is discussed analytically and numerically. An intrinsic stochastic interaction between the fluctuating electric field and the parallel ion current is observed and the saturation level is of the expected magnitude.

9312 **(JAERI-M—83-130) Evaluation of the error for electron temperature and density measurements on JFT-2 plasma.** Kawashima, Hisato; Yamauchi, Toshihiko; Matoba, Tohru. (Japan Atomic Energy Research Inst., Tokyo). Aug 1983. 25p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700224.

Electron temperature and density of the JFT-2 plasma have been measured by Thomson scattering method. Those data obtained from it sometime take an error within the same series of plasma discharges. Several causes are studied experimentally. First of all, shot noise of a photomultiplier is one of the dominant factors associated with the error. It is shown experimentally that there is a correlation between shot noise error and fluctuations to total photoelectrons. In addition to shot noise, the following are discussed; (1) jitter of duration time of gating circuit and fluctuation of plasma light, (2) jitter of photomultiplier's sensitivity, (3) lack of reproducibility of the plasma discharge. On a single discharge, shot noise usually gives dominant error. On the other hand, in the case of the average of m times discharges, an error to be caused by (1), (2) or (3) is larger than a shot noise error which is reduced by $1/\sqrt{m}$. It is shown that each error can be distinguished by chi^2 test or root mean square method. Thus the best data which contains only shot noise error can be selected reliably.

9313 **(JAERI-M—83-146) Mass separated neutral particle energy analyser.** Takeuchi, Hiroshi; Matsuda, Toshiaki; Miura, Yukitoshi; Shiho, Makoto; Maeda, Hikosuke; Hashimoto, Kiyoshi; Hayashi, Kazuo. (Japan Atomic Energy Research Inst., Tokyo). Sep 1983. 32p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700225.

A mass separated neutral particle energy analyser which could simultaneously measure hydrogen and deuterium atoms emitted from tokamak plasma was constructed. The analyser was calibrated for the energy and mass separation in the energy range from 0.4 keV to 9 keV. In order to investigate the behavior of deuteron

and proton in the JFT-2 tokamak plasma heated with ion cyclotron wave and neutral beam injection, this analyser was installed in JFT-2 tokamak. It was found that the energy spectrum could be determined with sufficient accuracy. The obtained ion temperature and ratio of deuteron and proton density from the energy spectrum were in good agreement with the value deduced from Doppler broadening of TiXIV line and the line intensities of H sub(α) and D sub(α) respectively.

9314 **(JAERI-M—83-159) Modal analysis of eddy current in JT-60 multi-torus system.** Ozeki, Takahisa; Nakamura, Yukiharu. (Japan Atomic Energy Research Inst., Tokyo). Oct 1983. 102p. NTIS (US Sales Only), PC A06/MF A01. File Number DE85700235.

For the purpose of plasma control analysis including an eddy current effect, numerical computations of eddy current in JT-60 tokamak were carried out using the computer program EDDY-MULT. Our numerical model of JT-60 tokamak includes most of main components such as a vacuum vessel, toroidal field coils, a central column and support plates, each of which have the complicated geometrical and electrical characteristics. 464 eigen modes of eddy current in this JT-60 multi-torus system were numerically obtained by the modal expansion technique. Typical contour maps of the obtained eddy current eigen functions were graphically illustrated. Linear parameters of the state-space model were numerically evaluated to perform the control analysis of JT-60 plasma current and position including an eddy current effect. The complicated magnetic structures produced by the corresponding eddy current mode were graphically illustrated.

9315 **(JAERI-M—83-162) Development of a high counting rate pulse height analyzing system for plasma diagnosis.** Matoba, Tohru; Ogawa, Toshihide; Kawashima, Hisato; Kimura, Toyoaki. (Japan Atomic Energy Research Inst., Tokyo). Oct 1983. 28p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE85700226.

New type pulse height analyzing system is developed and tested for Tokamak plasma diagnosis. Main developing targets are as follows. (1) Time resolving spectrum of X-ray or others can be measured at single discharge of tokamak plasma. (2) In the near future, this system will have capability of real time mode operation. The trial system is the high counting rate 4 channel pulse height analyzer by CAMAC standard, and it is demonstrated that this system desired specifications in measuring the soft X-ray spectrum in the JFT-2 Tokamak. These results give technological base for a practical system.

9316 **(JAERI-M—83-165) Stabilizing effect of passive conductors with arbitrary shape for positional instabilities.** Seki, Shogo; Ninomiya, Hiromasa; Yoshida, Hidetoshi. (Japan Atomic Energy Research Inst., Tokyo). Oct 1983. 11p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700236.

For positional instabilities in the tokamak, the stabilizing index nsub(s) is an adequate parameter to characterize the stabilizing effect produced by several kinds of passive conductors around a plasma column such as vacuum vessel and poloidal field coils. Since a system of passive conductors with arbitrary shape can be involved into multiple L-R circuits, this parameter nsub(s) of those passive conductors is expressed in a simple form by using a method of the eigen mode expansion of multiple L-R circuits. This parameter nsub(s) is very useful to estimate not only a growth rate of positional instability and its feedback stabilization but also an inward shift of plasma column due to a minor disruption.

9317 **(JAERI-M—83-171) Fluctuations observed in NBI heated Doublet III divertor discharges.** Konoshima, Shigeru; Aikawa, Hiroshi; Azumi, Masafumi. (Japan Atomic Energy Research Inst., Tokyo). Oct 1983. 42p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700222.

A specific type of activity associated with fairly large pulsive energy loss has been observed, predominantly during improved confinement (H-mode) discharges in the NBI heated Doublet III tokamak. Large repetitive bursts of edge recycling light with 2-5ms duration and 10ms intervals appear in the course of increasing βsub(p). The amount of energy released by a single burst is estimated to be at least 2-3% of stored energy. As a result of these periodic energy losses, attained values of plasma energy is evaluated to be depressed as much as 10%. Prior to a burst, large m=n=0 magnetic field oscillations of ~20kHz were observed with highly peaked distribution near the divertor region. No other particular activities which might be responsible for either the confinement deterioration or improvement have been found throughout the entire operational space.

9318 **(JAERI-M—83-190) Second harmonic ICRF heating in the JFT-2M.** Odajima, Kazuo; Matsumoto, Hiroshi; Kimura, Haruyuki. (Japan Atomic Energy Research Inst., Tokyo). Nov 1983. 28p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700223.

Pure second harmonic ion cyclotron heating experiments in hydrogen plasma were carried out in the JFT-2M tokamak. In order to improve an absorption characteristics in the second harmonic regime, neutral beam injection heating is used, and effective heating via ICRF is observed. With 550kW of NBI, the plasma is heated up to Tsub(i)=0.9keV, and Tsub(e)=1.1keV. 30ms after the start of NBI, 520kW of ICRF is applied and plasma is finally heated up to Tsub(i)=1.1keV, Tsub(e)=1.6keV. Magnetic measurement of $\Lambda+1/2 = \beta$sub(p) + (lsub(i) - 1)/2 increases by $\Delta\Lambda=0.3$ with ICRF heating. Preliminary coupling study of a wave guide coupler is also investigated. A parallel plate TEM electric field coupler, whose electric field configuration is almost the same as a ridged wave guide, are used as a simulater of a ridged wave guide coupler. The transmission coefficient with plasma is almost the same as the one obtained by loop antenna at low power level.

9319 **(NRL-MR—5483) Raman sidescattering in laser-produced plasmas.** Menyuk, C.R.; El-Siragy, N.M.; Manheimer, W.M. (Naval Research Lab., Washington, DC (USA)). 27 Dec 1984. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004440.

The theory of the Raman sidescattering instability in an inhomogeneous plasma is revisited. The growth rate is found from the eigenvalue of a second order ordinary differential equation in the Fourier domain. Under certain, rather easily satisfied constraints, the normalized growth rate depends on a single parameter involving laser strength, gradient scale length and resonant density.

9320 **(UCRL—90949-Rev.1) Spectroscopic study of sources and control of impurities in TMX-U. Revision 1.** Yu, T.L.; Allen, S.L.; Moos, H.W. (Johns Hopkins Univ., Baltimore, MD (USA); Lawrence Livermore National Lab., CA (USA)). Nov 1984. Contract W-7405-ENG-48;AC02-76ET53006. 21p. (CONF-841218—14). NTIS, PC A02/MF A01; GPO Dep. File Number DE85004423.

From 31. national vacuum symposium; Reno, NV, USA (3 Dec 1984).

Two absolutely calibrated euv instruments have been used to study the impurity characteristics in the Tandem Mirror Experiment-Upgrade (TMX-U). One instrument is a spectrograph that measures the time histories of several impurity emission lines in a single plasma shot. The other instrument is a monochromator that measures time-resolved radial profiles of a particular impurity emission line. The common intrinsic impurities found in TMX-U are C, N, O, and Ti. It has been shown that a large fraction of oxygen and nitrogen in the plasma is associated with the neutral beams. The plasma wall is the main source of carbon. In general, the concentration of each of the impurities is low (<1%), and the power radiated by them is less than 10 kW, which is a small portion of the total input power to the plasma. The concentrations of the impurities can be reduced substantially by glow discharge cleaning and titanium gettering.

9321 **(UWFDM—577) Pressure-gradient-driven tokamak resistive MHD instability in the banana-plateau collisionality regime.** Callen, J.D.; Shaing, K.C. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). Nov 1984. Contract AC02-80ER53104. 52p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85004568.

The moment equation approach to neoclassical processes is used to derive the linearized electrostatic perturbed flows, currents

and resistive MHD-like equations for a tokamak plasma. The new features of the resultant neoclassical MHD, which requires a multiple length scale analysis for the parallel eigenfunction but is valid in the experimentally relevant banana-plateau regime of collisionality, are: (1) a global Ohm's law that includes a fluctuating bootstrip current resulting from the parallel electron viscous damping (at rate μ/sub e/) of the poloidal flow due to the perturbed radial pressure gradient; (2) reduction of the curvature effects to their flux surface average because Pfirsch-Schlueter currents cancel out the lowest order geodesic curvature effects; (3) an increased polarization drift contribution with B^{-2} replaced by B^{-2}/sub theta/ where B/sub theta/ is the poloidal magnetic field component. An electrostatic eigenmode equation is determined. For the unstable fluid-like eigenmodes the new viscous damping effects dominate (by ϵ/sup -3/2/) over the curvature effects, but the growth rates still scale roughly like resistive-g or resistive-ballooning modes. Diamagnetic drift frequency corrections to these new modes are also discussed.

9322 **Transport theory: Microscopic reversibility and symmetry.** Molvig, K.; Hizanidis, K. (Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physics of Fluids;* **27**: No. 12, 2847-2858(Dec 1984).

The general theory of Fokker-Planck equation symmetries and their relation to derived transport theory symmetries is developed. The property of microscopic reversibility implies a symmetry in the Fokker-Planck equation for processes obeying detailed balance. It is shown that this symmetry is not sufficient to guarantee Onsager reciprocity for the full matrix of transport coefficients. The general transport matrix has broken symmetry. A partial symmetry can be identified. The theory is compared to the different formulation given by Onsager.

9323 **Limiter stabilization of high-beta external kink-tearing modes.** Lee, J.K.; Ohyabu, N. (GA Technologies Inc., San Diego, California 92138). *Physics of Fluids;* **27**: No. 12, 2874-2876(Dec 1984). Contract AT03-84ER53158.

The stabilizing effects of finite-width poloidal limiters, toroidal limiters, and general mushroom limiters are examined for high-beta finite resistivity tokamak plamas in free boundary. When the plasma pressure and resistivity are small, a poloidal limiter is effective in reducing the growth rate even with a small limiter size, while a toroidal limiter requires a large size for a comparable effect. As the plasma pressure or resistivity increases, a toroidal limiter becomes more effective in reducing the growth rate than a poloidal limiter of the same size. A small optimized mushroom limiter might have a stabilizing effect similar to a conducting shell.

9324 **Numerical study of the precessional instabilities in a symmetric tandem mirror with hot-electron end cells.** Tsang, K.; Lee, X.S.; Hafizi, B.; Antonsen, T.M. Jr. (Science Applications, Inc., Boulder, Colorado 80302). *Physics of Fluids;* **27**: No. 12, 2912-2917(Dec 1984). Contract AC03-76ET53057.

The axial eigenmode equation for a symmetric tandem mirror with hot electron end cells is solved numerically in a high-beta long-thin equilibrium. Stability of the precessional ballooning modes is studied in detail. It is found that stable regions in parameter space are severely restricted even for moderately long and dense center cell.

9325 **Spectroscopic study of scattered light at around the fundamental wavelength in UV laser-produced plasmas.** Tanaka, K.; Goldman, L.M.; Seka, W.; Short, R.W.; Williams, E.A. (Laboratory for Laser Energetics, University of Rochester, 250 East River Road, Rochester, New York 14623). *Physics of Fluids;* **27**: No. 12, 2960-2965(Dec 1984). Contract AC08-80DP40124.

Spectroscopic studies of scattered light from UV laser plasmas near the fundamental wavelength are reported. Three distinct spectral components are observed in these experiments. Doppler-broadened spectra are observed in transmitted light from thin targets and in specularly reflected light from tilted targets. At intensities above 10^{14} W/cm^2, stimulated Brillouin scattered spectra are measured in backscatter for both normal and oblique incidence of the laser. An additional new component is observed in backscattering from targets at normal incidence. This component is broad and blue-shifted, and is consistent with analytical model calculation based on filamentation.

9326 **Confinement of fusion reaction products during the fishbone instability.** Heidbrink, W.W.; Hay, R.; Strachan, J.D. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Physical Review Letters;* **53**: No. 20, 1905-1908(12 Nov 1984). Contract AC02-76CH03073.

The presence of fishbone events in the PDX tokamak is correlated with a reduction in the burnup of 0.8-MeV ^{3}He ions. This reduction is probably caused by distortion of the ^{3}He drift orbitals in the helical magnetic fields associated with the instability, resulting in the loss of about 70% of the confined ^{3}He ions in a moderately strong fishbone. Such a nonresonant loss of particles with large orbits indicates that fishbone events may influence 3.5-MeV alphas in ignition experiments.

9327 **New model of Raman spectra in laser-produced plasma.** Simon, A.; Short, R.W. (Laboratory for Laser Energetics, University of Rochester, Rochester, New York 14623). *Physical Review Letters;* **53**: No. 20, 1912-1914(12 Nov 1984). Contract AC08-80DP40124.

Observations of Raman scattering in laser-produced plasma can be explained by incoherent Thomson scattering, with a greatly enhanced "plasma line". Reversed-slope velocity distributions in the underdense region are produced by hot-electron pulses originating near the quarter-critical surface (n/sub c//4). The model explains the two gaps in the Raman spectrum, the correlation of scattering "onset" with that of instability at n/sub c//4, the "scintillation" in frequency and time, and the weak angular variation. An "upscattered" frequency band is predicted and has been verified by experiment.

9328 **Nuclear effects on ion heating within the small-angle charged-particle elastic-scattering regime.** Andrade, A.; Hale, G.M. (Los Alamos National Laboratory, Mail Stop B243, Los Alamos, New Mexico 87545). *Physical Review [Section] A: General Physics;* **30**: No. 4, 1940-1947(Oct 1984).

The effects of nuclear forces (in contrast to pure Coulomb interaction) on the ion heating rate which results from small-angle scattering processes between charged particles in plasmas are investigated within the framework of Fokker-Planck theory. These effects are included through the addition of analytic Coulomb-nuclear interference and nuclear elastic cross sections in the scattering integrals of the dynamical friction coefficient and dispersion tensor. It is found that corrections to traditional Fokker-Planck predictions of the ion-ion energy exchange rate can be calculated and that these corrections are sensitive to the choice of the maximum scattering angle defining the cutoff between small- and large-angle scattering.

9329 **Impurity ion transport studies on the PLT tokamak during neutral-beam injection.** Suckewer, S.; Cavallo, A.; Cohen, S. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Nuclear Fusion;* **24**: No. 7, 815-826(Jul 1984).

Radial transport of medium- and high-Z ions during co- and counter-neutral-beam heating in the PLT tokamak is studied, using molybdenum and scandium ions as tracer elements. The time evolution of the radial profiles of several ionization stages of both elements, injected by laser blowoff during the neutral-beam heating, is measured under three significantly different beam-plasma combinations. No noticeable differences in the radial profiles attributable to the beam direction are observed. However, a given injected amount resulted in considerably larger interior concentrations of the tracer element in the counter-beam heating cases, suggesting larger penetration of the plasma periphery. Computer simulation with the MIST code suggests a net inward drift of the order 10^3 cm.s^{-1} superposed to a diffusion coefficient of the order 10^4 cm^2.s^{-1} for both scandium and molybdenum ions. Injection of larger amounts of the tracer element, sufficient to cause measurable central electron temperature changes, resulted in dramatic changes in ion-state distributions, making some appear peaked in the centre while others disappeared. This effect could be produced with both co- and counter-beam heating, but with lesser amounts in the latter case. It is inter-

preted as rearrangement of the ionization balance, rather than any preferential accumulation of the injected element.

9330 **Numerical simulation of ion beam propagation in z-pinch plasma channels.** Mankofsky, A.; Sudan, R.N. (Cornell Univ., Ithaca, NY (USA). Lab. of Plasma Studies). *Nuclear Fusion;* **24**: No. 7, 827-849(Jul 1984).

Propagation of intense ion beams in performed z-pinch plasma channels, a scenario of interest for inertial confinement fusion devices, has been studied with a 2.5 -dimensional (r, z, vsub(r), vsub(theta), vsub(z); delta/deltatheta=0) hybrid simulation model. In the code, ions are represented by particles and electrons by an inertialess thermal fluid which obeys a generalized Ohm's law. Fields are solved in the quasi-neutral Darwin approximation. Several collisional and atomic processes are included. The simulations of this paper are performed with collisional effects scaled down by a factor of ten. The results are then extrapolated to estimate that propagation efficiencies in the 70% range are possible using 5-7 MeV, 1-2 MA proton beams with initial divergences in the range of 1.5 deg. to 7 deg. in a 4-m hydrogen channel. Current neutralization in excess of 99% is found, and no gross axisymmetric instabilities are observed. 38 refs.

9331 **Electron cyclotron resonance heating (ECRH) of a Spheromak plasma.** Granatstein, V.L.; Chu, K.R. (Laboratory for Plasma and Fusion Energy Studies). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **PS-12**: No. 2, 144-149(Jun 1984).

ECRH calculations are carried out for the MS Spheromak (B /SUB to/ = 20-25 kG, n /SUB e/ > or about $10^{14}cm^{-3}$) under the assumption of a straightline ray path. These preliminary calculations indicate that for "end-on" illumination of the Spheromak plasma by an extraordinary wave at the second harmonic of the cyclotron frequency, almost complete singlepass absorption is achieved even when electron temperature is low (< or about 100 eV). The use of gyrotrons currently under development would make an early experimental demonstration possible.

9332 **ECRH in Tandem Mirror machines.** Stallard, B.W. (Lawrence Livermore National Laboratory, University of California, Livermore, CA 94550). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **PS-12**: No. 2, 134-143(Jun 1984).

Electron cyclotron resonance heating (ECRH) is important in tandem mirror devices which incorporate thermal barriers to enhance plasma confinement. ECRH in the end cells generates hot mirrorconfined electrons to form the thermal barrier and creates the plugging potential to reduce ion end loss from the central cell. Important considerations for heating include a) the proper choice of wave polarization and harmonic number for wave penetration and efficient absorption, b) the possibility for control of hot electron energy and anisotropy by spatially limited heating, and c) the particle feed for hot electrons due to RF trapping processes. Fokker-Planck and Monte Carlo computer codes are useful for understanding these effects. The Tandem Mirror Experiment Upgrade (TMX-U) was constructed to investigate plasma confinement for the thermal barrier mode of operation. We carried out experiments to generate the hot electrons that are required for the thermal barrier. Heating efficiencies as large as 30 percent were observed. By combining the hot electron population with neutral-beam-injected hot ions and ECRH at the location of the desired potential peak, we strongly reduced the end loss of ions and measured plugging potentials up to 700 V. These results are consistent with the thermal barrier model.

9333 **Electron cyclotron heating experiments in tokamaks and stellarators.** England, A.C. (Fusion Energy Division, Oak Ridge National Laboratory, Oak Ridge, TN 37830). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **PS-12**: No. 2, 124-133(Jun 1984).

This paper reviews the application of high-frequency microwave radiation to plasma heating near the electron cyclotron frequency in tokamaks and stellarators. Successful plasma heating by microwave power has been demonstrated in numerous experiments. Predicted future technological developments and current theoretical understanding suggest that a vigorous program in plasma heating will continue to yield promising results.

9334 **Survey of lower hybrid experiments.** Porkolab, M. (Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, MA 02139). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **PS-12**: No. 2, 107-117(Jun 1984).

Recent results in lower hybrid experiments on tokamaks are surveyed. Both ion and electron heating regimes are examined. It is found that while good coupling of the RF power with multiple waveguide arrays can be achieved, the ion heating results tend to be irreproducible. Electron heating in high density plasmas, such as in Alcator C, tend to be efficient and reproducible. Perhaps the most exciting results have been obtained in RF current generation experiments where toroidal currents of the order of hundreds of kiloamperes have been generated by injecting several hundred kilowatts of power via traveling lower hybrid waves.

9335 **Linear theory of lower hybrid heating.** Bonoli, P. (Massachusetts Institute of Technology, Cambridge, MA 02139). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **PS-12**: No. 2, 95-107(Jun 1984).

The linear theory of wave propagation in the lower hybrid range of frequencies is presented. The topics of accessibility, linear and quasi-linear theories of electron Landau damping, and the linear theory of ion Landau damping are covered. The theory of wave propagation is extended to include the effect of toroidal geometry. A simulation model incorporating these theories is described and numerical results obtained with the model are given.

9336 **Review of ICRF experiments.** Colestock, P.L. (McDonnell Douglas Astronautics Company, St. Louis, MO 63166). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **PS-12**: No. 2, 64-79(Jun 1984).

The current status of ICRF experiments is reviewed with emphasis on high-power heating results in tokamaks. The rationale for the use of the fast magnetosonic wave is described along with simplified models for the wave coupling and power absorption. Experimental results are presented which confirm the essential features of the theoretical model and suggest a highly favorable prognosis for scaling the heating process to a reactor.

9337 **ICRF heating theory.** Perkins, F.W. (Plasma Physics Laboratory, Princeton University, P.O. Box 451, Princeton, NJ 08544). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **PS-12**: No. 2, 53-63(Jun 1984).

The fundamental aspects of plasma heating in the Ion Cyclotron Range of Frequencies (ICRF) are presented, with an emphasis on heating tokamak devices. Topics include wave propagation, minority heating, ion-ion hybrid mode conversion, second harmonic heating, evolution of the ion velocity distribution, and ICRF antenna design.

9338 **Radio frequency heating of plasmas using compressional Alfven waves.** Stix, T.H. (Princeton University, Princeton, NJ 08544). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **PS-12**: No. 2, 48-53(Jun 1984).

Two factors favor the use of relatively low frequencies (below a few megahertz) for heating large fusion plasmas. The first is that supplying the necessary few hundred megawatts of radio frequency power is already within current technological possibilities. The second is the exploitation of well-separated resonances of Alfven waves inside the plasma-filled reactor cavity to greatly simplify the antenna structure. The large minor radius and high plasma density in TFTR-class and reactor tokamaks will accommodate fast-wave toroidal eigenmodes at frequencies which are well below all the cyclotron frequencies of ions of the fuel gas and of most impurities (carbon, oxygen, iron). Electron transit-time magnetic pumping and Landau damping provide adequate absorption mecha-

nisms, but care is necessary to achieve RF power deposition deep inside the plasma.

9339 **The generation of current in Tokamaks by the absorption of waves in the electron cyclotron frequency range.** Antonsew, T.M.; Hui, B. (Science Applications, Inc., McLean, VA 22102). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **PS-12**: No. 2, 118-123(Jun 1984).

The theory of current generation due to the absorption of high-frequency waves is developed for the case in which the propagation of the waves is described in the geometrical optics approximation. An expression for the current generated is obtained which is similar in form to the expression for the rate of energy deposition. This expression is incorporated in a toroidal ray tracing code to study current generation due to the absorption of waves in the electron cyclotron frequency range. The dependence of the current generated on temperature and angle of injection for the joint Naval Research Laboratory-Oak Ridge National Laboratory experiment on ISXB is studied.

9340 **MHD description of plasma. Chapter 1.4.** Kulsrud, R.M. (Princeton Univ., NJ (USA). Plasma Physics Lab.). pp 115-145 of Basic plasma physics. 1. Galeev, A.A. (AN SSSR, Moscow. Inst. Kosmicheskikh Issledovanij); Sudan, R.N. (Cornell Univ., Ithaca, NY (USA). Lab. of Plasma Studies) (eds.). Amsterdam, Netherlands; North-Holland (1983).

Includes author and subject indexes.

Instead of specifying the plasma in terms of each of its particles a more macroscopic description can be pursued in which the emphasis is on its fluid nature. This fluid description may be a one-fluid, two-fluid, or many-fluid approach. The author discusses the various descriptions of both collisional and collisionless plasma.

9341 **Collisional transport in plasma. Chapter 1.5.** Hinton, F.L. (Texas Univ., Austin (USA). Fusion Research Center). pp 147-197 of Basic plasma physics. 1. Galeev, A.A. (AN SSSR, Moscow. Inst. Kosmicheskikh Issledovanij); Sudan, R.N. (Cornell Univ., Ithaca, NY (USA). Lab. of Plasma Studies) (eds.). Amsterdam, Netherlands; North-Holland (1983).

Includes author and subject indexes.

Transport processes in plasmas are responsible for the loss of particles and energy in situations where 'ideal' plasmas would be expected to be perfectly confined, and for the departure from ideal behavior in other situations as well. Among the mechanisms for plasma transport are (1) macroscopic instabilities, (2) turbulence due to microinstabilities, and (3) Coulomb collisions. Only the last mechanism is considered in this chapter. Only transport in MHD equilibrium systems is considered. The time rate of change of macroscopic quantities is assumed to be small, and due entirely to transport.

9342 **Theory of fluctuations in plasma. Chapter 2.3.** Oberman, C.R. (Princeton Univ., NJ (USA). Plasma Physics Lab.); Williams, E.A. (Rochester Univ., NY (USA). Lab. for Laser Energetics). pp 279-333 of Basic plasma physics. 1. Galeev, A.A. (AN SSSR, Moscow. Inst. Kosmicheskikh Issledovanij); Sudan, R.N. (Cornell Univ., Ithaca, NY (USA). Lab. of Plasma Studies) (eds.). Amsterdam, Netherlands; North-Holland (1983).

Includes author and subject indexes.

Even in a stable plasma, particle discreteness can constantly re-excite fluctuations. The presence of these fluctuations in general is responsible for diffusion and transport in the plasma. First, the one- and two-time hierarchies are developed and it is then shown how expectations are computed. The irreducible cluster expansions are introduced and related to the Klimontovich equation for the fluctuating microdensity. Fluctuations in a homogeneous plasma are considered in detail.

9343 **Variational principle for problems of ideal magnetohydrodynamic stability. Chapter 3.1.** Bertstein, I.B. (Mason Laboratory, Yale University, New Haven, CT, USA). pp 421-449 of Basic plasma physics. 1. Galeev, A.A. (AN SSSR, Moscow. Inst. Kosmicheskikh Issledovanij); Sudan, R.N. (Cornell Univ., Ithaca, NY (USA). Lab. of Plasma Studies) (eds.). Amsterdam, Netherlands; North-Holland (1983).

Includes author and subject indexes.

Using the model of ideal magnetohydrodynamics, the author develops the general theory for a plasma separated from perfectly conducting walls by a vacuum region. Two examples are given to demonstrate the techniques employed and the generality of the results obtained: a sufficient condition for stability for a magnetic field free plasma supported by a vacuum magnetic field is derived in terms of the curvature of the bounding surface; and Suydam's criterion for the stability of the diffuse linear pinch is derived.

9344 **Space-time evolution of plasma instabilities - absolute and convective. Chapter 3.2.** Bers, A. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Electrical Engineering). pp 451-517 of Basic plasma physics. 1. Galeev, A.A. (AN SSSR, Moscow. Inst. Kosmicheskikh Issledovanij); Sudan, R.N. (Cornell Univ., Ithaca, NY (USA). Lab. of Plasma Studies) (eds.). Amsterdam, Netherlands; North-Holland (1983).

An important aspect of linear instabilities in plasmas is the manner in which they evolve from initially small-amplitude perturbations of a given equilibrium. The linearized, dynamic plasma models that describe such instabilities cease to be valid when the amplitudes of unstable perturbations become appreciable, so that nonlinear effects, ignored in the original model, become important. In order to understand the manner in which linear instabilities modify a given equilibrium into a nonlinear state it is important to study their space-time evolution. The author presents specific examples that illustrate the various ways in which the general theory can be used to determine the space-time evolution of plasma instabilities. In addition, developments over the past decade in stability theory for inhomogeneous plasmas, particularly as they relate to the coupled-mode instabilities, are also integrated and described. 77 refs.

9345 **Kinetic waves and instabilities in a uniform plasma. Chapter 3.3.** Davidson, R.C. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). pp 519-585 of Basic plasma physics. 1. Galeev, A.A. (AN SSSR, Moscow. Inst. Kosmicheskikh Issledovanij); Sudan, R.N. (Cornell Univ., Ithaca, NY (USA). Lab. of Plasma Studies) (eds.). Amsterdam, Netherlands; North-Holland (1983).

Includes author and subject indexes.

This chapter presents a theoretical survey of the basic kinetic waves and instabilities characteristic of a spatially uniform plasma immersed in a uniform, applied magnetic field. A wide variety of kinetic instabilities are examined in which the free energy source for the instability is associated with nonthermal features of the equilibrium distribution function ranging from the relative directed motion of plasma components to anisotropy in plasma kinetic energy.

9346 **Resistive instabilities and field line reconnection. Chapter 3.5.** White, R.B. (Princeton Univ., NJ (USA). Plasma Physics Lab.). pp 611-676 of Basic plasma physics. 1. Galeev, A.A. (AN SSSR, Moscow. Inst. Kosmicheskikh Issledovanij); Sudan, R.N. (Cornell Univ., Ithaca, NY (USA). Lab. of Plasma Studies) (eds.). Amsterdam, Netherlands; North-Holland (1983).

Laboratory plasma devices are generally designed with ideal magnetohydrodynamic stability in mind, so it is not surprising that the next most rapid class of modes, the resistive instabilities, figure prominantly in the description of the behaviour of the plasmas achieved. In this chapter the linear and nonlinear plasma behaviour associated with simple scalar resistivity are reviewed. The notions of the existence of magnetic surfaces, the coupling of field and plasma, and the relaxation of this strict coupling brought about by finite scalar resistivity, are reviewed. The linear theory of recon-

nection for a plane current layer is reviewed. Then the nonlinear theory of tearing-mode development and the implications for understanding toroidal magnetic confinement devices is reviewed. Finally, the implications of the presence of a background of small magnetic islands are considered. 126 refs.

9347 **Radiation processes in plasmas. Chapter 1.3.** Griem, H.R. (Maryland Univ., College Park (USA)). pp 73-113 of Basic plasma physics. 1. Galeev, A.A. (AN SSSR, Moscow. Inst. Kosmicheskikh Issledovanij); Sudan, R.N. (Cornell Univ., Ithaca, NY (USA). Lab. of Plasma Studies) (eds.). Amsterdam, Netherlands; North-Holland (1983).

The author summarizes the developments made in quantitative theoretical descriptions of the various radiation processes. Electromagnetic radiation processes in plasmas fall into two broad categories: the atomic processes involving changes in the state of electrons that can be considered parts of an atom or ion and, perhaps, even of a molecule; processes that involve the plasma in a more essential way and for which the radiating electrons cannot be ascribed to some atomic or molecular system. 115 refs.

9348 **Linear wave propagation in ideal magnetohydrodynamics. Chapter 2.1.** Weitzner, H. (New York Univ., NY (USA). Courant Inst. of Mathematical Sciences). pp 201-242 of Basic plasma physics. 1. Galeev, A.A. (AN SSSR, Moscow. Inst. Kosmicheskikh Issledovanij); Sudan, R.N. (Cornell Univ., Ithaca, NY (USA). Lab. of Plasma Studies) (eds.). Amsterdam, Netherlands; North-Holland (1983).

Includes author and subject indexes.

A general discussion of the structure and properties of the equations of ideal magnetohydrodynamics is presented. This is followed by a description of solutions of various problems of wave propagation and associated phenomena.

9349 **Propagation and mode-conversion for waves in nonuniform plasmas. Chapter 2.4.** Stix, T.H. (Princeton Univ., NJ (USA)); Swanson, D.G. (Auburn Univ., AL (USA)). pp 335-366 of Basic plasma physics. 1. Galeev, A.A. (AN SSSR, Moscow. Inst. Kosmicheskikh Issledovanij); Sudan, R.N. (Cornell Univ., Ithaca, NY (USA). Lab. of Plasma Studies) (eds.). Amsterdam, Netherlands; North-Holland (1983).

Includes author and subject indexes.

The authors consider the case for a wave propagating through an inhomogeneous plasma and approaching a region where the local plasma parameters would correspond to a coalescence of wave numbers. The incident wave may be reflected or refracted in the same mode, or absorbed, or converted into the complementary mode, or undergo some combination of these. Mode-conversion theory is addressed to this question.

9350 **Geometric optics in space and time varying plasmas. Chapter 2.5.** Bernstein, I.B.; Friedland, L. (Yale Univ., New Haven, CT (USA)). pp 367-418 of Basic plasma physics. 1. Galeev, A.A. (AN SSSR, Moscow. Inst. Kosmicheskikh Issledovanij); Sudan, R.N. (Cornell Univ., Ithaca, NY (USA). Lab. of Plasma Studies) (eds.). Amsterdam, Netherlands; North-Holland (1983).

Includes author and subject indexes.

One of the central phenomena of plasma physics is the propagation of electromagnetic waves. For applications such as radio-frequency heating or probing one requires a treatment which allows one actually to construct the fields numerically, even when the geometry of the plasma is complex, and the parameters characterizing the plasma vary in space and time. In general the problem requires the joint solution of Maxwell's equations for the electromagnetic field, and a system of kinetic equations for the plasma, and the description may be nonlinear, so the task is clearly formidable. Fortunately in many interesting cases the amplitudes of the fields are weak, which allows use of linearized theory, and the waves are characterized by wavelengths short compared with the scale lengths and frequencies large compared with the time rates of change which characterize the macroscopic properties of the plasma such as density, temperature, quasi-static magnetic field, etc. Then an approximate description via geometric optics is feasible which allows the construction of the field by means of the integration of a system of ordinary differential equations.

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REFER ALSO TO CITATION(S) 7002008809, 8810, 8811, 8937, 9003, 9236, 9274

9351 **(BMFT-FB-T—84-165) Condensation of light gases with large cryopumps.** Buettner, P.; Klipping, G. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Freie Univ. Berlin (Germany, F.R.). Inst. fuer Atom- und Festkoerperphysik). Aug 1984. 90p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE85750073.

In contact with the Design Team of the Joint European Torus (JET) project accompanying research and development regarding the operation of large cryopumps has been performed. The design of a bath-type cryopump with a condensation surface A = 2000 cm^2 and a pumping speed s = 20 000 l/s for hydrogen is described. For investigations with this pump methods for measuring the temperature distribution at the condensation surface, the pumping speed and the thickness of the growing condensate have been developed and are described in detail. The performance data of the cryopump as well as results of measurements of the pumping speed for hydrogen and deuterium, the vapour pressure of these gases, the obtainable final pressure and instabilities of the condensed gas layers are given. The final chapter deals with the available knowledge on cryosorption of hydrogen, deuterium and helium based on a literature survey.

9352 **(CONF-8411121—3) ORNL helical-axis stellarator studies.** Harris, J.H. (Oak Ridge National Lab., TN (USA)). Nov 1984. Contract AC05-84OR21400. 31p. NTIS, PC A03. File Number TI85003683.

From US/USSR atomic energy agreement for scientific and technical cooperation for peaceful usage meeting; Moscow, USSR (12 Nov 1984).

The addition of an l = 1 helical winding to the Heliac central conductor adds a significant degree of flexibility to the configuration by making it possible to control the rotational transform and shear. Such control is essential for an experiment because the presence of low-m resonant surfaces in or near the plasma can cause break-up of the equilibrium magnetic surfaces. To further improve the equilibrium β limits for low aspect ratio configurations, it is necessary to reduce the toroidal magnetic axis shift. The results indicate that an increase in aspect ratio and number of field periods is the most effective means of improvement.

9353 (INIS-SU—259, pp 11-17) **To the choice of lay-out scheme and main parameters of the vacuum system for INTOR.** Gurin, S.P.; Karasev, B.G.; Mazul', I.V.; Odintsov, V.N.; Saksaganskij, G.L.; Serebrennikov, D.V.; Fefelov, P.A. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)); Pistunovich, V.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1982. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number TI85780020. (CONF-8106209—Vol.4).

From 2. all-union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (23 Jun 1981).

Vacuum-physical parameters and conditions for operation of the elements of the vacuum tract of the INTOR reactor, are presented. The chamber variant made as a sectioned shell firmly fixed on the internal surface of elements of the stationary shield, is suggested. Blanket elements are placed in the zone of high vacuum and are protected by sectioned cooled first wall which is to be made of stainless chromenickel steels of the austenite class. The first wall is protected by the magnetic field of the divertor shape. Divertor plates are to be performed as a two-layer design: substrate-water cooled pipe of zirconium alloy and the layer of sprayed material of tungsten, molybdenum and their alloys. The pumping out of the divertor chamber is performed through 12 channels by high-vacuum pumps; the action rate in helium of each of them must be 1.2×10^5 l/s. For reactor pumping out the following types of vacuum pumps seem to be perspective: condensation (approximately 4K) pumps, cryosorption pumps on the base of microporous adsorbing agents or condensed gases (10 approximately 30 K), sorption pumps on the

basis of nonsprayed metallic getters - for pumping out D-T mixture; (4 K)cryosorption umps (approximately) on the basis of microporous adsorbents - for pumping out helium. The suggestions described are placed in the foundation of the Soviet INTOR project.

9354 (INIS-SU—259, pp 69-76) **Experimental study on the dense metallic plasma interaction with a solid surface.** Afinogenov, E.P.; Rashevskaya, M.N.; Chekalin, Eh.K.; Yurevich, T.V. (Gosudarstvennyj Nauchno-Issledovatel'skij Ehnergeticheskij Inst., Moscow (USSR)). 1982. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number TI85780020. (CONF-8106209—Vol.4).

From 2. all-union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (23 Jun 1981).

To study processes of plasma interaction with the wall of fusion reactor, gas dynamic and thermal processes of interaction of dense plasma (plasma focus) which appears in electromagnetic plasma accelerator of the erosion type with the surface of the solid body, are investigated. Targets made of copper, tungsten, aluminium, brass, steel 18Kh made of flat and profiled form with wall thickness of 1 mm are used as bodies investigated. It is shown that the fracture of target material in the case of interaction with plasma focus takes place due to strong radiation-convective effect. The share of radiation in the process of fracture is approximately 60% from plasma energy during interaction with the target.

9355 (INIS-SU—259, pp 82-87) **Thermonuclear reactor first wall from hydrogen-soluting materials.** Fiks, M.M. (Nauchno-Proizvodstvennoe Ob"edinenie Ehnergiya, Moscow (USSR)). 1982. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number TI85780020. (CONF-8106209—Vol.4).

From 2. all-union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (23 Jun 1981).

Possibilities of application of hydrogen dissolving materials as the first wall of a fusion reactor, are discussed. The possibility of fuel transfer (D-T mixture) through such a wall is pointed out. The possibility of establishing a protective layer of cold plasma on the internal surface of the first wall by using evaporating and condensing properties of titanium coating saturated with hydrogen, is also shown.

9356 (INIS-SU—259, pp 89-96) **Calculation of radiation effect on the first wall of a pulsed thermonuclear reactor.** Kolgatin, S.N.; Stepanov, A.M.; Khachatur'yants, A.V. (Leningradskij Politekhnicheskij Inst. (USSR)). 1982. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number TI85780020. (CONF-8106209—Vol.4).

From 2. all-union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (23 Jun 1981).

Numeric methods have been used to investigate the interaction of electromagnetic radiation and fusion reaction products with the protective layer of the first wall. Estimates and calculations are performed for liquid lithium considered as the main element of the protective layer. Pressure and density distributions of the layer substance, phase trajectories of points of the layer, maximum pressure dependence on pulse duration, are presented.

9357 (INIS-SU—259, pp 97-105) **Effect of soluted gas bubbles on the dynamical properties of the liquid first wall of a pulsed thermonuclear reactors.** Kravchuk, S.P.; Novikov, V.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1982. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number TI85780020. (CONF-8106209—Vol.4).

From 2. all-union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (23 Jun 1981).

To study the possibility of using molten salts on the basis of fluorides of metals as the first wall of the pulsed thermonuclear reactor (PTR), mechanical behaviour of the layer of a liquid containing cavitation embryo in the form of gas bubbles after its pulsed heating with a flux of thermonuclear neutrons have been numerically studied. Conclusions are made on the use of molten-salt first wall in PTR. It is shown that liquid salt is "stronger" than steel. When there are enough gas bubbles in liquid, reloading wave amplitude becomes rather small. Radii of oscillating bubbles in this case change but slightly, so that bubbles do not stick together and due to this do not create the split-off region. Therefore, molten salt first wall can be used in the pulsed fusion reactor.

9358 (INIS-SU—259, pp 106-111) **Calculation of radiation losses in the electromagnetic trap with the power gain factor Q>=1.** Karpukhin, V.I.; Lavrent'ev, O.A.; Sappa, N.N. (AN Ukrainskoj SSR, Donetsk. Fiziko-Tekhnicheskij Inst.). 1982. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number TI85780020. (CONF-8106209—Vol.4).

From 2. all-union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (23 Jun 1981).

Radiation loadings on construction elements of electromagnetic traps (EMT) such as anode diaphragms, cathodes, closing electrodes, first wall are investigated. The geometry, of toroidal multipole with aspect ratio $\gamma=R/r$ sub(pl)=3, where R and rsub(pl.) is the large and small radii of plasma formation with the number of magnetic slots N=10 and their seiwidth a=0.1 cm is taken as a model for calculation. Magnetic field in slots Bsub(s) is 50a-100 K Gs, plasma radii are 50-150 cm, which corresponds the parameters of the scale of large plasma devices of the tokamak type. It is supposed that to heat plasma electron injection alone will be used. The conclusion is made that emitter and anodes will be subjected to the strongest specific loadings; corpuscular loadings on the first-wall are comparatively moderate and permit to provide a rather long operation pulse of reactor due to slow administration of admixtures into plasma. It is shown that production of electrodes of refractory metals (tungsten, molybdenum), their effective cooling, application of special collectors to decrease particle fluxes to anodes and the following increase of emitter square; some reduction in the specific power of D-T fusion in plasma volume - all these steps will bring about safe and durable exploitation of EMT with Q>1.

9359 (INIS-SU—259, pp 154-160) **Vacuum aspects of the divertor of the TO-2 tokamak.** Kuzin, E.F.; Pustovojt, Yu.M.; Rabin, A.A.; Svishchev, V.S.; Stolyarov, V.L. 1982. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number TI85780020. (CONF-8106209—Vol.4).

From 2. all-union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (23 Jun 1981).

The design and characteristics of the toroidal axially asymmetric TO-2 tokamak divertor are described. The pumping-out of gas which is formed during neutralization on the accepting plate of ions that come to divertor from plasma is performed due to sorption of gas particles by a titanium film placed on the surface of a nitride, located inside the divertor chamber. To place titanium on the surface of nitrides, titanium evaporation from the cathode spot of the vacuum arc, is used. Two arc evaporators are placed into each of the divertor chambers, their cathodes being simultaneously accepting divertor plates. Nitride shell serves as anode. Results of experimental studies show that 10-second titanium coating between pulses provides effective divertor pumping-out for 50 μs at plasma density in the TO-2 $n=5\times10^{13}$ cm^{-3} and lifetime of charged particles tau=10 μs. Titanium film continues to rather effectively pump out hydrogen during repeated passings, into the divertor without titanium renovation on nitride surface. First experiments at the TO-2 in the plasma regime have proved high pumping-out characteristics of the nitride divertor system.

9360 (INIS-SU—259, pp 185-192) **Solid-hydrogen pellet injection into a torsatron - reactor.** Karpukhin, V.I.; Rudakov, V.A.; Sappa, N.N. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1982. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number TI85780020. (CONF-8106209—Vol.4).

From 2. all-union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (23 Jun 1981).

Parameters of fuel pellets necessary for injection into thermonuclear reactor-torsatron, are calculated. Calculations are performed for three-turn torsatron-reactor with parameters R=34 m, a=1.7 m, $n=5\times10^{14}$ cm^{-3}, T=7.5 keV, V=7.3 T, thermal reactor capacity Psub(T)=11.6 GW. Dependences of the velocity of injected pellets and relative power fluctuations on the depth of fuel penetration, density and temperature excitations at the moment of end of pellet evaporation in the approximation of the model of plasma

screening, are calculated. On the basis of these dependences, the necessary dimensions and velocities of pellet injection are determined which meet the requirement of condition for excitation relaxation of plasma density and permissible level of power oscillations in torsatron reactor. The results given prove the possibility of maintaining stationary burning in torsatron-reactor using the injection of fuel grains. The preliminary analysis shows that the problem is more successfully solved in torsatron reactor than in tokamak.

9361 (INIS-SU—259, pp 201-208) **Foam shield for the pulsed thermonuclear reactor first Wall.** Andreev, M.A.; Kantan, V.V.; Khachatur'yants, A.V. (Leningradskij Politekhnicheskij Inst. (USSR)). 1982. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number TI85780020. (CONF-8106209—Vol.4).

From 2. all-union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (23 Jun 1981).

The concept of foam shielding of the first wall of fusion reactors with inertial confinement is considered. The foam is cell gas-liquid medium with a small volumetric liquid content, which is stable for a long period of time due to addition of surface active substances in the liquid. All estimations and calculations are made for most widely-spread air-water foam. Chamber filling with foam can be uniform, nonuniform or partial (i.e. near-wall). The calculations performed have found out the main advantages of foam protection: 1) practically complete absorption of all types of radiation except neutron radiation; 2) the most effective damping of shock waves as compared with other media; 3) possibility of controlling the degree of neutron moderation and the final medium state; 4) technological simplicity and low energy capacity of foam formation process.

9362 (INIS-SU—259, pp 209-217) **Study on physical-chemical and gasodynamical processes in implosion products.** Samujlov, E.V.; Rozhdestvenskij, I.B.; Pleshanov, A.S.; Borisov, V.I.; Kortsenshtejn, N.M. (Gosudarstvennyj Nauchno-Issledovatel'skij Ehnergeticheskij Inst., Moscow (USSR)). 1982. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number TI85780020. (CONF-8106209—Vol.4).

From 2. all-union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (23 Jun 1981).

To study the processes in products of target dispersion in chambers of inertial fusion reactors, the method of calculating thermodynamic properties and thermodynamic equilibrium composition of heterogeneous chemically reacting systems, is developed. The following model of the system is used: the gaseous phase is considered as a mixture of ideal chemically reacting gases (reactions of ionization or electron sticking to atoms or molecules can be a private case of chemical reaction); condensed phases are considered either as ideal solutions of liquid or solid components, or as a phase of pure substances. The presence of condensed phases in the system is determined on the basis of analysis of experimental data. Peculiarities of the above method of calculation are demonstrated using the example of a two-phase system, which comprises the gaseous phase and one condensed phase which is an ideal solution.

9363 (INIS-SU—259, pp 242-248) **Vacuum chamber wall erosion by unipolar arcs in stellarators.** Burchenko, P.Ya.; Vojtsenya, V.S.; Volkov, E.D.; Gribanov, Yu.A.; Dikij, A.G.; Samojlov, V.P.; Solodovchenko, S.I. 1982. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number TI85780020. (CONF-8106209—Vol.4).

From 2. all-union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (23 Jun 1981).

Results of comparison of topography peculiarities of magnetic field and character of chamber wall damage by unipolar arcs are presented using as examples "Sirius" and "Uragan-2" stellarator. Microphotographies of chamber wall surface in erosion places and data on the number of metal impurity atoms, falling on the wall, are given. On the basis of the data presented the following conclusions can be made: 1) region and area of vacuum chamber wall damage by unipolar arcs in the stellarator to a considerable degree are determined by magnetic field topography; 2) the trace of unipolar arc presents a sequence of overlapping craters; 3) successive arc formation on heterogeneities of wall surface can result in a considerable local ejection of its material mass; 4) entrance of metal impurities to plasma at the expense of the chamber surface erosion by unipolar arcs can be considerably decreased in the modification of stellarator system of torsatron type with a divertor.

9364 (INIS-SU—259, pp 271-277) **To the problem of measuring tritium recovery in a flibe under the action of 14 MeV neutrons.** Kapyshev, V.K.; Novikov, V.M.; Sakharov, V.I.; Fedotov, S.N.; Chuvilin, D.Yu. 1982. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number TI85780020. (CONF-8106209—Vol.4).

From 2. all-union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (23 Jun 1981).

Measurement technique of tritium small quantities produced in the investigated blanket model of a thermonuclear reactor (TNR) on the basis of lithium and beryllium fluoride salt melts from neutron source with the energy 14 MeV has been studied. A modernized neutron generator served as a neutron source. Neutron output is approximately 10^{10} neutron/s. Model of TNR blanket presents a sphere 400 mm in diameter, gradually filled with the melt of lithium and beryllium fluoride salts in the ratio 50 per 50 mol %. Target of neutron generator is placed in the centre of the model. The investigated flibe samples are located in radial channel of the model and presented cylinders 4 cm^3 in volume. Evaluation of the required irradiation time taking into account neutron source intensity and sensitivity of measurement equipment is made on the basis of calculations according to the "BLANK" program. Tritium produced in flibe is determined by scintillation method using crystallization concentration of tritium, in flibe, in aqueous phase with subsequent water purification from dissolved part of the sample matrix. It follows from the results obtained that the technique tested of tritium measurement in flibe proved to be efficient and permitted to measure tritium low concentrations up to 10^{-8} Qi/g.

9365 (INIS-SU—259, pp 299-302) **Tritium system for fuel regeneration of tokamak type thermonuclear reactors.** Mukhamet-Galeeva, S.Sh. (Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Neorganicheskikh Materialov, Moscow (USSR)). 1982. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number TI85780020. (CONF-8106209—Vol.4).

From 2. all-union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (23 Jun 1981).

A schematic flowsheet of the tritium system for fuel regeneration of tokamak-type thermonuclear reactors has been considered. The presented system of deuterium and tritium recovery from gaseous mixture permits to automate the process using simple devices of automatic control. The system can operate both under continuous and cyclic regimes. Adsorbers in the recovery system can be manufactured in the form of several unified geometrically congruent sections for the easy operation and replacement which ensures a continuous recovery and an optimum working capacity of the system.

9366 (INIS-SU—259, pp 303-309) **Main problems in designing blankets of hybrid thermonuclear reactors.** Gornostaev, B.D.; Gur'ev, V.V.; Epinat'ev, A.M.; Kuz'min, E.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1982. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number TI85780020. (CONF-8106209—Vol.4).

From 2. all-union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (23 Jun 1981).

Problems concerning the development and creation of hybrid blanket systems of tokamak-reactors are presented in a brief form. A presumed construction flowsheet of a blanket of experimental-industrial thermonuclear power station and design of an experimental blanket module are described.

9367 (INIS-SU—259, pp 326-329) **Experimental study on the model of a liquid-metal blanket of a tokamak-type reactor.** Karasev, B.G.; Lavrent'ev, I.V. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)); Birzvalk, Yu.A. (AN Latvijskoj SSR, Riga. Inst. Fiziki). 1982. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number TI85780020. (CONF-8106209—Vol.4).

From 2. all-union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (23 Jun 1981).

A construction flowsheet of blanket, in which direct current is supplied to lithium channels for partial compensation of pressure drop, conditioned by liquid lithium movement in a strong magnetic field, is suggested. Experimental tests of MHD-device, modelling such blanket, is reported. The work carried out testifies to the possibility of flow distribution control in conduction MHD-channel placed in a strong enough magnetic field and having the structure, modelling liquid-metal blanket.

9368 (INIS-SU—259, pp 330-337) **Hydraulic resistance of liquid-metal coolants in a blanket of tokamak-type thermonuclear reactor.** Zhinkina, V.B.; Zhokhov, K.A.; Kozlova, L.V.; Firsova, Eh.V. (Nauchno-Proizvodstvennoe Ob"edinenie po Issledovaniyu i Proektirovaniyu Ehnergeticheskogo Oborudovaniya, (USSR)). 1982. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number TI85780020. (CONF-8106209—Vol.4).

From 2. all-union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (23 Jun 1981).

Experimental studies have been carried out to obtain data on certain types of MHD-resistance of liquid metal coolants in the blanket of a hybrid reactor. The investigations are made using sodium bench with forced circulation of liquid metal over closed contour. The investigated elements of MHD-resistance are in the field of permanent electromagnet with induction vector directed in perpendicular to metal movement. The main parameters of the experiment constituted: sodium temperature 500 deg K, flow rate 0.2-5.0 m/s, magnetic induction 0-1 T, criteria-Re=7000-16000, Ha=190-2700, parameter of MHD interaction N=0.4-810. The channel walls are manufactured of conducting material-stainless steel Kh18N9T, the value of conductivity parameter, at that, varied in the limits 0.01-0.04. Different types of MHD flows are investigated. Geometrical parameters of channels and dependences, generalizing experimental and calculation data, are presented.

9369 (INIS-SU—259, pp 338-345) **To the choice of thermal circuit and unit parameters of a hybrid thermonuclear power plant with a tokamak-type reactor.** Gorbatykh, V.P.; Rassokhin, N.G.; Abrashov, V.A.; Zhukov, S.I.; Ryabov, V.M. (Moskovskij Ehnergeticheskij Inst. (USSR)). 1982. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number TI85780020. (CONF-8106209—Vol.4).

From 2. all-union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (23 Jun 1981).

Different thermal flowsheets of two-circuit hybrid thermonuclear power station with a gaseous coolant are discussed. Special attention is paid to the choice of thermal accumulator. Accumulator of phase transition (APT) "melting-solidification" is considered, T-Q diagram of APT being presented. A considerable drawback of the APT-shocks of gas temperature at the inlet (from 600 deg C during charging and to 300 deg C during discharge)-is pointed out. Steam-water accumulators (SWA) do not have the drawback. Principle of overcritical SWA operation is described. A monocontour flowsheet with water-cooled blanket at saturation temperature and turbine with saturated steam can be recommended as the most easily realized solution for creation of demonstration hybrid thermonuclear power station with a tokamak reactor operating in quasistationary regime.

9370 (INIS-SU—259, pp 353-359) **Stabilization of pulsed reactor gasodynamical parameters by means of a damper volume.** Baranov, G.A.; Vatin, N.I.; Gontsov, N.G.; Marinov, V.G.; Mikhajlov, V.A.; Ryajsyanen, A.G.; Tananaev, A.V.; Chudov, A.V. (Leningradskij Politekhnicheskij Inst. (USSR)). 1982. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number TI85780020. (CONF-8106209—Vol.4).

From 2. all-union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (23 Jun 1981).

Experimental study of the process of gas parameter change in the system of several pulsed thermonuclear reactors operating per one damper volume has been carried out. Pulse energy separation is modelled by pressure pulse, pulsed thermonuclear reactor-by high-pressure chamber. Pressure pulse is created by means of rapid opening of valve on pipe line between pulse and damper chambers. Experimental study has shown that the change of regime and hydraulic parameters of the system produces a considerable effect on the process of pressure change in the damper chamber. Totality of the calculation and experimental data confirms the possibility to reach a high degree of stability of working body parameters using gasodynamic method of stabilization.

9371 (INIS-SU—259, pp 361-368) **Experimental study on the neutron-physical parametrs of the flibe blanket of a thermonuclear reactor.** Novikov, V.M.; Zagryadskij, V.A.; Chuvilin, D.Yu. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1982. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number TI85780020. (CONF-8106209—Vol.4).

From 2. all-union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (23 Jun 1981).

Neutron physical parameters of blanket model on the basis of Li and Be fluoride salts have been studied by the different methods. Experimental model of salt blanket presented a sphere 400 mm in diameter filled with flibe (eutectic mixture of lithium and beryllium fluoride salts - LiF, BeF_2 in the ratio 48 per 52 mol.%). In the experiment effect of lead and bismuth multiplication zone on the fission rate of ^{232}Th and ^{235}U has been studied. Multiplication zones of lead and bismuth are installed in the internal region of the model. A neutron generator, using DT-reaction, serves as a source of neutrons with the energy 14 MeV. The output of the neutron generator constituted approximately 10^{10} n/s. The conclusion is made that the use in measurements on blanket zone of modules of fission chamber and threshold activation indicators provides a possibility to obtain informative results with a low measurement error. Comparison of the experimental results with the calculation ones showed their considerable discrepancy, which is most probably connected with inaccuracy of used in calculation nuclear data of elements included in the composition of fuel assembly studied.

9372 (INIS-SU—259, pp 369-376) **Study on the energy conversion in plasma flow through a magnetic field in a shock tube.** Zajtsev, S.G.; Nikolaev-Kozlov, V.K.; Favorskaya, I.K.; Chebotareva, E.I. (Gosudarstvennyj Nauchno-Issledovatel'skij Ehnergeticheskij Inst., Moscow (USSR)). 1982. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number TI85780020. (CONF-8106209—Vol.4).

From 2. all-union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (23 Jun 1981).

Analytical and experimental study of ionized plasma flow through magnetic gasodynamic channel (MGDC) has been carried out. The MGDC is joined to the face end of a shock tube. Plasma formed during shock wave reflection from the face end flows through MGDC to a receiver. A quasimonomeric model of the process is suggested. The problem of plasma flow time through MGDC is analyzed. The process of plasma flow formation in MGDC and the effect of the intensity of magnetic gasodynamic interaction on the process is investigated. Experimental data on the flow parameter distribution in MGDC are obtained. A monomer model of ionized gas flow through reflecting nozzle and MGDC joined to the shock tube, is suggested. The calculation results are compared with the experiment. It is shown that at B=O a satisfactory agreement is observed. At B not equal O a qualitative coincidence of wave pictures only for initial time moments (start processes) is observed; at later time moments (during brake wave formation), as shown in the experiment, the dimeric effects, which are not taken into consideration in the calculation, play a significant role.

9373 (INIS-SU—259, pp 377-383) **Energy conversion system for the TROL hybrid reactor.** Vasil'ev, N.N.; Lebedeva, N.B (AN SSSR, Moscow. Inst. Vysokikh Temperatur); Barbashinov, I.M.; Krivokhizhin, V.G. (LO Gidroproekt). 1982. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number TI85780020. (CONF-8106209—Vol.4).

From 2. all-union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (23 Jun 1981).

A thermal flowsheet of the TROL hybride reactor design with ambipolar plasma confinement is described. Uranium zone of

blanket (metal uranium) and face end energy receivers and burial grounds of plasma beams, flowing out of the trap are the main sources of high-potential heat in the reactor. A flowsheet of water-cooled uranium-graphite fission reactor RBMK-P-2400 with steam overheating is selected as a prototype of thermal flowsheet of the TROL reactor. Energy parameters of the thermal flowsheet of the TROL reactor and ways to solve the tasks of safety under different emergency regimes are given.

9374 (INIS-SU—259, pp 384-390) **Technique for hydrogen production from water with iron-oxide thermochemical cycle and a thermonuclear reactor as a heat source.** Branitskij, Ya.B.; Nurgaliev, R.M.; Satanovskij, V.R. (AN SSSR, Moscow. Inst. Vysokikh Temperatur). 1982. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number TI85780020. (CONF-8106209—Vol.4).

From 2. all-union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (23 Jun 1981).

A scheme of water thermochemical decomposition, with iron-oxide cycle has been considered. The thermonuclear reactor is used as a heat source. Technological flowsheet of the installation and its parameters obtained as a result of optimizational calculations are presented. The calculated efficiency factor values constitute about 40%.

9375 (INIS-SU—259, pp 391-397) **Some techniques for direct conversion of thermal energy of a plasma from the mirrors of a hybrid magnetic mirror reactor.** Vinogradova, O.A.; Dimitrov, S.K.; Makhin, A.V.; Smirnov, V.M.; Tel'kovskij, V.G. (Moskovskij Inzhenerno-Fizicheskij Inst. (USSR)). 1982. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number TI85780020. (CONF-8106209—Vol.4).

From 2. all-union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (23 Jun 1981).

As applied to hybrid magnetic mirror reactor (HMR) several recuperation systems are analyzed, efficiency of energy conversion of charged particle flux from the reactor mirrors is evaluated. Experimental results obtained using laboratory model, constructed according to the flowsheet flat magnetic expander-system of tapered, diaphragms (STD) are presented. The model has the dimensions 100 times lower the real ones. Using a scarce electron beam the trajectories of charged particle movement in the recuperation system are modelled and the influence of edge effects in the magnetic expander on the efficiency of direct conversion is studied. Recuperation flowsheet with a tapered expander, in which magnetic field expansion is realized in two directions, proved to be more compact. The conclusion is made that the absence of the necessity of preliminary plasma expansion, which permits to get rid of the expander and to considerably reduce the recuperator dimensions, is the main advantage of the recuperator. The necessity to create a strong magnetic field in a great volume, the value order of which equals the field in the reactor mirrors, is the main disadvantage.

9376 (INIS-SU—259, pp 398-405) **Turbulent plasma blanket for a tokamak reactor.** Vasil'ev, N.N.; Nedospasov, A.V.; Tokor', M.Z. (AN SSSR, Moscow. Inst. Vysokikh Temperatur). 1982. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number TI85780020. (CONF-8106209—Vol.4).

From 2. all-union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (23 Jun 1981).

Technical aspects of the use of turbulent plasma blanket in tokamak reactor are discussed. The notion of turbulent plasma blanket based on the increase of plasma diffusion coefficient in near-wall region up to the values of Bohm order under conditions of high plasma recycling at the first wall is suggested. Creation of the conditions will permit to ensure a low enough temperature of near-wall plasma from the viewpoint of wall erosion. It is shown that at technically achievable degree of magnetic field stochastization the turbulent plasma blanket can be substituted for a divertor. It complies with the main functions of a divertor: leading out of helium and unburnt fuel from the working volume; maintenance of impurity concentration at the level considerably lower the critical one for self-sustained thermonuclear reaction.

9377 (INIS-SU—259, pp 406-412) **Choice of a design of the cooling system accumulator for a tokamak reactor uranium zone blanket.** Baryshnikov, N.L.; Galushkin, S.N.; Gur'ev, V.V.; Smetannikov, V.P.; Solonin, V.I. (Moskovskoe Vysshee Tekhnicheskoe Uchilishche (USSR); Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1982. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number TI85780020. (CONF-8106209—Vol.4).

From 2. all-union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (23 Jun 1981).

Various designs of heat accumulators converting spasmodically changing thermal power of thermonuclear reactor into the direct thermal power provided to the energy consumer: steam generator, turbine etc, are discussed. It is pointed out that accumulator, using phase transition heat is the best for the given purposes. As heat accumulated material the preference is given to metal alloys, for example, to eutectic alloy aluminium-copper-silicon. Calculation results of the dependence of diameter of a cylindrical heat accumulating element, accumulator length and hydraulic resistance on the density of mass consumption and element pitch are presented. The calculated distributions of temperature over the radius of cylindrical heat accumulating element in the end of pulse and pause are presented.

9378 (INIS-SU—259, pp 319-325) **Study on the hydrodynamics of liquid lithium in a hybrid module of a thermonuclear reactor.** Ehl'kin, A.I.; Gekht, G.M.; Nagornyj, M.M. (Gosudarstvennyj Nauchno-Issledovatel'skij Ehnergeticheskij Inst., Moscow (USSR)); Topil'skij, L.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1982. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number TI85780020. (CONF-8106209—Vol.4).

From 2. all-union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (23 Jun 1981).

Numerical studies of magnetic hydrodynamics of liquid lithium flow in a hybrid module of quasistationary thermonuclear reactor-tokamak are carried out. Calculation results of rate distribution of lithium movement in channels and collectors of the blanket are presented.

9379 (INIS-SU—259, pp 421-427) **Space-energetic distributions of fast neutrons in alternating sheets of blanket materials and thermonuclear reactor shields.** Broder, D.L.; Gromov, L.A.; Gureev, V.I.; Petrzhak, K.A.; Teplykh, V.F.; Leshchiner, M.E.; Khandurov, N.V.; Kovrigin, B.S.; Gotlib, D.I.; Matvejkov, N.I. (Moskovskij Ehnergeticheskij Inst. (USSR). 1982. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number TI85780020. (CONF-8106209—Vol.4).

From 2. all-union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (23 Jun 1981).

Spectra measurements of slowing-down neutrons with the initial energy 15 MeV in iron, fiber glass and heterogeneous mixture from the above-mentioned material (50% iron and 50% fiber glass) of thermonuclear reactor containment are made. Measurements in the materials mentioned are made under geometrical conditions close to infinite ones. The measurement results of spatial and enery distributions of energy group neutrons 14.0-15.0, 10.5-14.0, 6.5-10.5, 4.0-6.5, 3.0-4.0 MeV in fiber glass, iron and their alternating layers are presented in a graphic form and in a table. Lengths of neutron relaxation are calculated. It is shown that neutron fluxes in all the measured thicknesses of fiber glass have the minimum in the energy range 7.5-12.0 MeV, in all thicknesses of iron in the range 8.0-14.0 MeV, and for alternating layers the minimum is at 8.0-12.0 MeV. Reasons for anomalous phenomena in neutron energy distributions are explained.

9380 (INIS-SU—259, pp 257-264) **Tritium isolation from lithium inorganic compounds applicable to thermonuclear reactor breeding blanket.** Vasil'ev, V.G.; Ershova, Z.V.; Nikiforov, A.S. (Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Neorganicheskikh Materialov, Moscow (USSR)). 1982. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number TI85780020. (CONF-8106209—Vol.4).

From 2. all-union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (23 Jun 1981).

Tritium separation from inorganic lithium compounds: Li_2O, $LiAlO_2$, Li_2SiO_3, Li_4SiO_4, LiF, $LiBeF_3$, Li_2BeF_4 irradiated with a beam of a gamma facility and a nuclear reactor, has been studied. In the first case the gas phase is absent. In the latter one the tritium amount in the gas does not exceed 1-2% of its total amount in the salt. Based on the EPR spectra of irradiated salts the concentrations of paramagnetic centres are calculated. It is shown that during thermal annealing the main portion of tritium in the gas phase is in the form of oxide (HTO, T_2O). Tritium is separated from lithium fluoroberyllates in the form of hydrogen (HT, T_2). The kinetics of tritium oxide isolation from irradiated lithium oxide aluminate, metha- and orthosilicates, lithium sulphate has been studied. The activation energies of tritium oxide separation process are presented. A supposition is made that chemical reaction of the HTO (T_2O) or HT(T_2) or HF(TF) formation is a limiting stage. Clarification of the process stage limiting the rate of tritium recovery will permit to evaluate conditions for the optimum work of lithium material in the blanket, lithium zone to select the lithium element structure and temperature regime of irradiation.

9381 (INIS-SU—259, pp 265-270) **Possibilities of tritium separation from lithium and lithium-lead eutectics when using them in thermonuclear reactors.** Petrov, B.V.; Ershova, Z.V. (Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Neorganicheskikh Materialov, Moscow (USSR)). 1982. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number TI85780020. (CONF-8106209—Vol.4).

From 2. all-union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (23 Jun 1981).

The process of vacuum distillation of tritium from melts of lithium or lithium-containing alloys has been considered. Techniques for theoretical calculation and optimization of the main parameters of tritium distillation from metal melts are developed. An expression is obtained to determine an elementary coefficient of separation during evaporation into vacuum. The elementary parameter of the process efficiency is calculated. It is found that tritium recovery from metal melts is realized most efficiently in the form of reciprocating-flow process by means of jet vacuum distillation at t deg =800-1000 K. Expected indices for optimized vacuum distillation are presented.

9382 (INIS-SU—259, pp 284-287) **Problems of radiation safety at Angara-5 facility.** Erkin, D.G.; Zhemchuzhnikov, G.N.; Kozlov, V.I.; Pal'vanov, V.Ch.; Dvoryaninov, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1982. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number TI85780020. (CONF-8106209—Vol.4).

From 2. all-union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (23 Jun 1981).

Problems of radiation safety, when designing the "Angara-5" thermonuclear facility, are considered. Special attention is paid to technological provision of radiation safety determination of thickness and composition of radiation shields as well as to monitoring the environmental radioactivity during maintenance operations. Dependences of dose rates on the time interval after one thermonuclear pulse production for two variants of the chamber vessel manufactured of AMg-6 aluminium and 12Kh18N10T steel, are presented. Thickness of radiation shields of iron-serpentinite concrete is suggested to be equal 2.1 m at a dose attenuation factor of 10^8.

9383 (INIS-SU—259, pp 278-283) **Design tritium contamination of cooling media of first wall and diverting plates of a plasma chamber.** Ershova, Z.V.; Vinogradova, N.K.; Evgrafova, D.I. (Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Neorganicheskikh Materialov, Moscow (USSR)). 1982. (In Russian). NTIS (US Sales Only), PC A19/MF A01. File Number TI85780020. (CONF-8106209—Vol.4).

From 2. all-union conference on engineering problems of thermonuclear reactors; Leningrad, USSR (23 Jun 1981).

Using INTOR reactor as an example, calculations on the evaluation of diffusion leak of tritium through the first wall of discharge chamber and divertors are made. It is clear from the obtained calculation data on the expected contamination of cooling water that in the case of a long-term reactor operation the tritium concentration in water can reach a hundred curie per litre. To avoid possible contaminations of the reactor rooms and tritium loss into the environment, a high reliability of the cooling system operation is required. To decrease the radiation risk when choosing structural materials both for divertors and the first wall, it is necessary to take into account the diffusion characteristics of metals and to provide protective coatings or other means decreasing tritium diffusion loss.

9384 (IPP—1/227) **Investigation for the removal of tritium by organic compounds; TROC process. Pt. 1.** Weichselgartner, H.; El-Sharnouby, A. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Apr 1984. 29p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE85750099.

Both, present day nuclear power plants as well as future fusion installations show an increasing release of gaseous tritium. Hazardous concentrations within the containments of reactors or large fusion devices can be reduced by effective detritiation systems. Some time ago, besides the conventional oxidation/absorption method, a new process was introduced which applies tritium removal by organic material (TROC process). In presence of noble metal catalysts unsaturated fatty acids like eruic acid captures hydrogen (and tritium) quantitatively. The catalytic hydrogenation reaction of eruic acid was investigated under various conditions in order to optimize the basic chemical reaction. One test with tritium was also performed. The experimental results are discussed; the optimum parameters will be applied in a pilot rig which is designed to process a 6 m^3 glove-box.

9385 (JAERI-M—83-120) **Conceptual design of swimming pool type tokamak power reactor (SPTR-P).** (Japan Atomic Energy Research Inst., Tokyo). Sep 1983. 550p. (In Japanese). NTIS (US Sales Only), PC A23/MF A01. File Number DE85700228.

A preliminary design study of a tokamak power reactor utilizing the deuterium/tritium/lithium fuel cycle based on a swimming pool type reactor (SPTR) concept is presented. Its primary aim is to investigate the characteristics of the swimming-pool concept in which water replaces much of the steel normally required for shielding. The major design features are: steady state operation, RF wave for plasma heating and current drive, solid tritium breeder material (Li_2O), modified austenitic stainless steel as first wall and blanket structural material, pumped limiter for ash exhaust, unified assembling of blanket and vacuum vessel and pressurized water cooling. The huge and heavy solid shield structure protecting superconducting magnets which brings about great difficulties in repair and maintenance is eliminated by submerging the reactor in a water pool. The water plays a role of shielding. In addition the water shield concept reduces radioactive waste disposal and to ease radiation streaming shielding. Key design parameters are: net electric power of 1000 MW, fusion power of 3200 MW, neutron wall loading of 3.3 MW/m^2, major radius of 6.9 m, plasma radius of 2.0 m, plasma elongation of 1.6, plasma current of 16 MA, total beta of 7 %, toroidal field on axis of 5.2 T.

9386 (JAERI-M—83-125) **Evaluation of structural reliability for vacuum vessel under external pressure and electromagnetic force.** Minato, Akio. (Japan Atomic Energy Research Inst., Tokyo). Aug 1983. 153p. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. File Number DE85700238.

Static and dynamic structural analyses of the vacuum vessel for a Swimming Pool Type Tokamak Reactor (SPTR) have been conducted under the external pressure (hydraulic and atmospheric pressure) during normal operation or the electromagnetic force due to plasma disruption. The reactor structural design is based on the concept that the adjacent modules of the vacuum vessel are not connected mechanically with bolts in the torus inboard region each other, so as to save the required space for inserting the remote handling machine for tightenning and untightenning bolts in the region and to simplify the repair and maintenance of the reactor. The structural analyses of the vacuum vessel have been carried out under the external pressure and the electromagnetic force and the structural reliability against the static and dynamic loads is estimat-

ed. The several configurations of the lip seal between the modules, which is required to make a plasma vacuum boundary, have been proposed and the structural strength under the forced displacements due to the deformation of the vacuum vessel is also estimated.

9387 **(JAERI-M—83-139) Preliminary study on the concept of steady fusion experimental reactor (FER) by RF-current drive.** Sugihara, Masayoshi; Nishio, Satoshi. (Japan Atomic Energy Research Inst., Tokyo). Sep 1983. 35p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE85700229.

Conceptual studies on steady state Fusion Experimental Reactor (FER) by using rf-current drive are made. Primary emphasis of the studies is placed on drawing the most advantageous feature of a steady-state fusion reactor. The studies are based on the present-day data base. As for rf wave, two kinds of rf wave are studied expecting progress of research in the future. Major items of the studies are 1) plasma confinement performance. 2) choice of rf waves for current drive 3) plasma major radius 4) size of toroidal field coil 5) equilibrium magnetic field configuration. The result of the studies reveals a possibility of smaller-size reactors than the standard one by 1--1.5 m in plasma major radius.

9388 **(JAERI-M—83-154) Dynamic property of fast shutter for JT-60 NBI.** Mukaida, Hidetoshi; Kuriyama, Masaaki; Araki, Masanori. (Japan Atomic Energy Research Inst., Tokyo). Sep 1983. 23p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700237.

To evaluate the dynamic property of a pneumatic drive type fast shutter of the prototype injector unit for JT-60, a computer code which simulated the fast shutter motion was developed. By using the code, it became clear that the shutter motion was affected considerably by the volume of a reservior tank of compressed gas, the conductance of gas feeder pipes, and the open and close timing of gas introduce value. Furthermore condition for stable movements of the shutter was clarified. The cause of malfunction which occurred in the performance test of the shutter, and the method of improvements were investigated.

9389 **(JAERI-M—83-177) Experimental study of induced activity in type 316 stainless steel by irradiation in D-T neutron fields.** Ikeda, Yujiro; Seki, Yasushi; Maekawa, Hiroshi; Oyama, Yukio; Nakamura, Tomoo. (Japan Atomic Energy Research Inst., Tokyo). Oct 1983. 79p. NTIS (US Sales Only), PC A05/MF A01. File Number DE85700231.

Experiments on induced activities in type 316 stainless steel (SUS316) have been performed in order to verify an induced activity calculation code system, THIDA, by using the FNS facility. Sample of 10 mm diameter x 2 mm t SUS316 were irradiated in three different D-T neutron fields. One sample was positioned at 10 cm from the target with no assembly around it and the other two placed inside the Li_2O-C pseudospherical blanket assembly. After irradiation, spectra of gamma-rays emitted from produced activities in each sample were successively measured by using a 60 cm^3 Ge(Li) detector following the cooling times from 10 min to about one month. The gamma-ray spectra and relative doses were compared with those calculated by THIDA. All the measured and calculated total gamma-ray intensities and relative doses agreed with each other within 15 % with one exception. Though the agreements were good as a whole, there were some disagreements in the individual gamma-ray intensities. The disagreements were investigated from the viewpoints of the THIDA code system and their nuclear data library.

9390 **(JAERI-M—83-194) Outline of the JFT-2M device. Design, construction, test.** Shoji, Teruaki; Odajima, Kazuo; Mori, Masahiro. (Japan Atomic Energy Research Inst., Tokyo). Dec 1983. 242p. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85700230.

The JFT-2M device in JAERI is described, including design studies and preparatory experiments. It is a tokamak device with non-circular cross section capable of high-β operation with an axisymmetric simple divertor. The device is used to study the following issues : 1) hybrid control of noncircular high-β Plasma, 2) stable low q discharge, 3) INTOR-type simple divertor, 4) ICRF heating in high temperature plasma, and 5) current sustain by LHRH.

9391 **(JAERI-M—83-195) Measurements of angle-dependent neutron spectra from lithium-oxide slab assemblies by time-of-flight method.** Oyama, Yukio; Maekawa, Hiroshi. (Japan Atomic Energy Research Inst., Tokyo). Nov 1983. 78p. NTIS (US Sales Only), PC A05/MF A01. File Number DE85700232.

The cylindrical lithium-oxide slabs were bombarded with 15 MeV D-T neutrons. The angle-dependent spectra were measured for neutrons leaking from the central area of the assemblies over the energy range from 0.5 to 15 MeV. The cylindrical slab system was adopted in order to examine the angular dependence of the multiple scattered neutrons in the two-dimensional system. The experiment was carried out to obtain benchmark data to verify the nuclear data and methods for the fusion blanket neutronics. The results of the measured input and output spectra of the assemblies are compiled in graphs and numerical tables. The experimental conditions are described in detail. The neutron spectra were measured by a time-of-flight method using an NE213 liquid scintillator and by a well-defined collimator system. The thicknesses of the measured assemblies were 5.06, 20.24 and 40.48 cm, and the measured angles were 0.0, 12.2, 24.9, 41.8 and 66.8 degrees. The characteristics of measuring system and the experimental errors are also discussed. The overall systematic errors of experimental values are estimated to be within +- 5 % for the energy scale and -2 -- +5 % for the magnitude of flux, respectively.

9392 **(JAERI-M—83-196) Measurements of tritium production-rate distribution in simulated blanket assemblies at the FNS.** Maekawa, Hiroshi; Tsuda, Koichi; Ikeda, Yujiro; Oyama, Yukio; Fukumoto, Toru; Seki, Yasushi; Nakamura, Tomoo; Iguchi, Tetsuo. (Japan Atomic Energy Research Inst., Tokyo). Nov 1983. 19p. (NEACRP-L—268). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700233.

A new powerful D-T neutron source FNS was constructed in Japan Atomic Energy Research Institute. Tritium production-rate (TPR) distributions were measured in simulated fusion blanket assemblies using the FNS. They were pseudo-spherical lithium oxide assembly with a graphite reflector and 40 cm thick lithium-oxide slab assembly. Three methods applied to measure the TPR were (A) Dierckx's method, (B) Self-irradiation method using a LiF thermoluminescence dosimeter and (C) Liquid scintillation counting method using sintered Li_2O pellets. Methods (B) and (C) have been developed in the JAERI. Measured TPR distributions agreed well among the three methods. It has been demonstrated that methods (B) and (C) are very useful for the fusion neutronics experiments. Experimental results support the P. G. Young's evaluation for $^7Li(n,n'\alpha)\ ^3T$ cross section.

9393 **(JAERI-M—83-204) In-pile experiment for tritium release from Li_2O under high neutron fluence. Detritiation and tritium monitoring.** Yoshida, Hiroshi; Matsui, Tomoaki; Kurasawa, Toshimasa; Miyauchi, Takejiro; Takeshita, Hidefumi; Kajimoto, Yoichi; Goto, Takanori; Watanabe, Kozo; Naruse, Yuji; Watanabe, Hitoshi. (Japan Atomic Energy Research Inst., Tokyo). Nov 1983. 32p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE85700240.

In-pile experiment for tritium release from sintered lithium oxide pellets was performed under high neutron fluence as a feasibility study of Li_2O for the tritium breeding material of a fusion reactor. The experiment (VOM- 15H Program) was carried out with the research reactor JRR-2 (irradiation hole; VT-10, thermal neutron flux; 1 x 10^{14} n/cm^2. sec) from May 23 to August 5, 1983. The effective irradiation time and the total production of tritium were 990hrs and 31Ci (observed), respectively. The average concentration of tritium in He sweep gas from the in-pile capsule was about 5μCi/cm^3. In order to reduce tritium release to the environment and to keep safety in tritium handling, the experimental apparatus was equipped with a detritiation system composed of a catalytic oxidizer and two molecular sieve dryers in a hood. This report describes the method of tritium monitoring and the results as well as the performance of the detritiation system.

9394 (JAERI-M—83-219) Neutron yield monitors for the fusion neutronics source (FNS) for 80° beam line. Maekawa, Hiroshi; Ikeda, Yujiro; Oyama, Yukio; Yamaguchi, Seiya; Nakamura, Tomoo. (Japan Atomic Energy Research Inst., Tokyo). Dec 1983. 32p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700234.

A powerful D-T neutron source named FNS (Fusion Neutronics Source) has been constructed in Japan Atomic Energy Research Institute. Measurement of absolute neutron yield is essential for fusion neutronics study. The associated α-particle method is the most suitable method for the determination of absolute yield of neutrons produced by $^{3}T(d,n)^{4}He$ reaction. For the 80° beam line of the FNS, an α-monitor using a silicon surface-barrier detector (SSD) has been installed as the main neutron yield monitor. A long counter and a ^{232}Th fission counter are adopted as the sub-monitors. A thin aluminum foil is set in front of the SSD to reduce the intensity of back-scattered deuterons. The peaks in the pulse height spectrum detected by the SSD are separated by the aluminum foil and by adjusting the bias voltage of the SSD. The peaks are assigned by means of the time-of-flight method for the associated charged-particles. A method to eliminate the contribution of d-^{3}He and d-D reactions has been developed. The absolute d-T neutron yield can be estimated accurately to within less than 2 % in the best case condition. The ratios of counts of the sub-monitors to the α-monitor have been observed to be stable within their statistical errors during the same experimental period.

9395 (JAERI-M—83-220) Thermal capability of JT-60 magnetic limiter plate. Ando, Toshiro; Nakamura, Hiroo. (Japan Atomic Energy Research Inst., Tokyo). Dec 1983. 31p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE85700239.

Thermal analysis of the JT-60 magnetic limiter (ML) plate has been made to investigate the thermal capability for its use in the ML operation. The following heat load models are considered to simulate the possible thermal conditions in the operation. Gaussian heat flux distribution with a half width of 3 cm is considered as charged particle heat load. In order to simulate the swing of the separatrix magnetic surface on the ML plate, both time averaged and sinusoidally moving heat flux are used. The effect of remote cooling by radiation (photon and charge exchanged neutral particle) in the ML region is modeled by the spacially distributed radiative heat sources. The ML plate is modeled by 2-dimensional slab geometry allowing interface conductance between the ML plate and the cooling duct. The effect of radiative heat transfer to the cooling duct and convective heat transfer to the cooling gas are included. Results show that in general the operation with the maximum heating pulse length of 10 s is not allowable in the absence of remote cooling. In a typical case when radiation loss in the ML region amounts to 70 % of the total power flow to the ML chamber, the power flow to the ML plate reduces by half and the peak heat flux also reduces by half or more. In addition, this heat flux is further decreased by half with +- 3.5 cm swing. This analysis presents the relationship between various heat loads and the ML plate temperature and hence the thermally allowable operational range on the ML plate.

9396 (Juel—1876) Examinations for the determination of the flux density of sputtered iron using laser induced fluorescence. Schweer, H.B. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Plasmaphysik; Association Euratom-Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.); Bochum Univ. (Germany, F.R.)). Nov 1983. 136p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE85750078.

In this work investigations are described to measure the flux density of sputtered iron atoms by means of laser induced fluorescence. In a laboratory experiment an iron target (stainless steel 316, Inconel 600), was bombarded with 10 keV Ar^{+} and 2.5 keV H^{+} and the population distribution of the energy levels of the ground state a ^{5}D and the metastable state $a^{5}F$ was measured. In the plasma wall region in the ISX-B tokamak at the Oak Ridge National Laboratory (USA) neutral iron atoms were measured the first time by laser induced fluorescence. A detection limit of 10^{6} atoms/cm^{3} was found and sputtered iron atoms were observed in the first 15 ms of the discharge.

9397 (KFK—3696) Review of results of research and development work carried out by the Institut fuer Technische Physik in 1983. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Technische Physik). Feb 1984. 40p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number TI85750483.

At the Institute for Technical Physics (ITP), the emphasis of the studies lies with the application of full-load superconductivity, the main tasks being part of the nuclear fusion project. Additionally, magnet technology for applications in other fields of research and development is advanced. The technical research programme goes together with fundamental research in the fields of cryogenics and superconductors as well as with related studies.

9398 (KMSF-U—1488) VAX Professional Workstation goes graphic. Downward, J.G. (KMS Fusion, Inc., Ann Arbor, MI (USA)). 1984. Contract AC08-82DP40152. 13p. (CONF-841249—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003692.

From Fall DECUS symposium; Anaheim, CA, USA (10 Dec 1984).

The VAX Professional Workstation (VPW) is a collection of programs and procedures designed to provide an integrated workstation environment for the staff at KMS Fusion's research laboratories. During the past year numerous capabilities have been added to VPW, including support for VT125/VT240/4014 graphic workstations, editing windows, and additional desk utilities. Graphics workstation support allows users to create, edit, and modify graph data files, enter the data via a graphic tablet, create simple plots with DATATRIEVE or DECgraph on ReGIS terminals, or elaborate plots with TEKGRAPH on ReGIS or Tektronix terminals. Users may assign display error bars to the data and interactively plot it in a variety of ways. Users also can create and display viewgraphs. Hard copy output for a large network of office terminals is obtained by multiplexing each terminal's video output into a recently developed video multiplexer front ending a single channel video hard copy unit.

9399 (LA-UR—84-3575) Internal field probing of translating FRCs. Armstrong, W.T.; Chrien, R.E.; Milroy, R.D. (Los Alamos National Lab., NM (USA); Mathematical Sciences Northwest, Inc., Bellevue, WA (USA)). Nov 1984. Contract W-7405-ENG-36. 5p. (CONF-8411111—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003732.

From Japan/US joint symposium on compact toroid research; Hiroshima, Japan (13 Nov 1984).

Magnetic field probes have been employed to study the internal field structure of Field-Reversed Configurations (FRCs) translating past the probes in the FRX-C/T device. Internal closed flux surfaces can be studied in this manner with minimal perturbation because of the rapid transit of the plasma (translation velocity v/sub z/ ~ 10 cm/μs). Data have been taken using a 5-mtorr-D_2 gas-puff mode of operation in the FRC source coil which yields an initial plasma density of ~ 1 x 10^{15} cm^{-3} and x/sub s/ ~ 0.40. FRCs translate from the ~ 25 cm radius source coil into a 20 cm radius metal translation vessel. Of many translation conditions studied, the condition considered here is translation into a weak guide field resulting in expansion of the FRC to conditions of density ~ 3 x 10^{14} and x/sub s/ ~ 0.7. The expected reversed B/sub z/ structure is observed. Evidence of island structure is also observed. Fluctuating levels of B/sub Θ/ are observed with amplitudes less than or equal to $B_0/3$ and values of flux ~ 4 x the poloidal flux. Values of β on the separatrix of β/sub s/ ≅ 0.3 (indexed to the external field) are implied from the field measurements. This decrease of β/sub s/ with increased x/sub s/ is expected, and desirable for improved plasma confinement.

9400 (LBL—18500, pp 27-31) **Neutral-beam development.** Aug 1984. NTIS, PC A04/MF A01. File Number DE85003166.

In Accelerator and Fusion Research Division: summary of activities, 1983.

Negative-ion-based systems are now viewed as having fewer limitations than positive-ion systems, largely because they can be more efficiently neutralized at high energies. Nonetheless, much important preliminary work on neutral beams involved positive ions.

Short-pulse (0.5 second) positive-ion sources and beam lines were developed at LBL for TFTR and Doublet III, and a prototype long-pulse source has been designed and tested. Further testing and technology transfer to industry will continue into 1986. The current shift of emphasis to negative ions reflects the need for high beam energies, whether to confine plasmas in mirror reactors or to penetrate the sizable plasmas of advanced tokamaks for heating or refueling. Our work on negative-ion systems has included work on two kinds of sources - one that generates ions at a biased cesiated surface and one that produces ions in a hot plasma - and on a promising acceleration and transport system, the transverse field focusing accelerator. For neutral-beam development, we rely on several test facilities, each in effect a neutral-beam injection system. The largest of these facilities, the 120-kV, 50-A Neutral Beam Engineering Test Facility, is used for positive-ion source development but is slated for conversion to a negative-ion facility beginning in 1986.

9401 (LBL—18500, pp 31-34) **Atomic physics and theoretical studies.** Aug 1984. NTIS, PC A04/MF A01. File Number DE85003166.

In Accelerator and Fusion Research Division: summary of activities, 1983.

Concurrent with the design and testing of neutral-beam systems, work continued in 1983 on developing diagnostic techniques for measuring beam impurities, atomic and molecular species distributions, and source and beam characteristics. Basic and applied theoretical work was also pursued with the aim of better understanding the processes and interactions that occur in plasmas.

9402 **(RAL—84-058) Implosion hydrodynamics.** Evans, R.G. (Rutherford Appleton Lab., Chilton (UK)). Jun 1984. 76p. NTIS (US Sales Only), PC A05/MF A01. File Number DE85700227.

Implosion hydrodynamics are examined, from the conditions in the imploded target to the initial target configuration and the driver performance. The subject is discussed under the topic headings: inertial configuration, thermonuclear fusion processes, ignition model, shock waves, acceleration by a constant pressure, spherical shock waves and imploding flows, drive pressure requirements, pulse shaping, pressure generation by lasers and ion beams, symmetry and hydrodynamic stability and typical target designs.

9403 **(UCID—30209) MFTF sensor verification computer program.** Chow, H.K. (Lawrence Livermore National Lab., CA (USA)). 9 Nov 1984. Contract W-7405-ENG-48. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004452.

The design, requirements document and implementation of the MFE Sensor Verification System were accomplished by the Measurement Engineering Section (MES), a group which provides instrumentation for the MFTF magnet diagnostics. The sensors, installed on and around the magnets and solenoids, housed in a vacuum chamber, will supply information about the temperature, strain, pressure, liquid helium level and magnet voltage to the facility operator for evaluation. As the sensors are installed, records must be maintained as to their initial resistance values. Also, as the work progresses, monthly checks will be made to insure continued sensor health. Finally, after the MFTF-B demonstration, yearly checks will be performed as well as checks of sensors as problem develops. The software to acquire and store the data was written by Harry Chow, Computations Department. The acquired data will be transferred to the MFE data base computer system.

9404 **Performance of Zr—Al getter pumps under transient load conditions.** Emerson, L.C.; Mioduszewski, P.K.; Simpkins, J.E. (Metals and Ceramics and Fusion Energy Divisions, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **2**: No. 4, 1583-1588(Oct 1984). Contract AC05-84OR21400.

Testing of the pump limiter concept in the Impurity Study Experiment (ISX-B) tokamak will involve the use of Zr—Al nonevaporable getter pumps capable of handling intermittent pulses of hydrogen and/or deuterium in the presence of carbon and oxygen impurity concentrations of several percent. To study the pumping characteristics under these conditions we have installed a Zr—Al cartridge pump in a vacuum chamber equipped with a fast gas puff feed system, a quadrupole residual gas analyzer, and a high speed ion gauge for transient pressure measurements. In this paper we report on the performance of the pump over a wide range of gas loads up to that sufficient to provide tens of monolayers of coverage of the getter surface. With flow rates up to 13 Torr l/s, pumping speeds for hydrogen were measured to be 1200—1500 l/s at pressures up to 10 mTorr. The measurements were carried out with gas pulses ranging in length from 50 ms to over 1 s and under conditions that provided a constant pumping speed for impurity species.

9405 **High-power ICRH launcher development.** Mullen, J.H.; Davis, J.W. (McDonnell Douglas Astronautics Company, St. Louis, MO 63166). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **PS-12**: No. 2, 79-95(Jun 1984).

In order to have successful and reliable high-power ion cyclotron resonance heating (ICRH) launchers operating in 5-MW power range by 1986-1988 time range, much research and development work is required. A discussion of the major electrical and thermodynamic problems associated with development of these high-power launchers is presented and two candidate high-power launchers are described in detail. One, an integrally tunable cavity-backed U-slot, can be flush mounted, can operate at high power, and can be tuned over a 2:1 frequency band. The other, a dielectrically loaded U-slot, can also be flush mounted, also operates at high power, but can operate at lower frequencies. Required tests and test scenarios for both hot (with plasma) and cold (no plasma) facilities are discussed. In addition, a brief discussion of potential reactor relevant ICRH materials is also included.

9406 **A resonant-cavity ICRF coupler for large tokamaks.** Perkins, F.W.; Kluge, R.F. (Plasma Physics Laboratory, Princeton University, P.O. Box 451, Princeton, NJ 08544). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **PS-12**: No. 2, 161-172(Jun 1984).

A new resonant cavity ICRF coupler is proposed for large tokamaks. The design features a novel resonant cavity, an RF magneticfield orientation that effectively radiates fast Alfven waves, matching to 40-Ω transmission lines, and an electric-field orientation so that the strongest RF electric fields are orthogonal to the main toroidal magnetic field, thereby benefiting from magnetic insulation. As a result, the power handling capability is excellent. For the case of the "Big-Dee" Doublet III tokamak, a single 35 X 50-cm coupler can launch 20 mW of fast Alfven waves. Extrapolation to fusion reactor parameters is straightforward.

9407 **Thermodynamics of liquid hydrogen solutions.** Sherwood, A.E.; Souers, P.C. (Lawrence Livermore National Laboratory University of California, Livermore, California 94550). *Nuclear Technology;* **5**: No. 3, 350-355(May 1984).

A theory of multicomponent liquid hydrogen solutions is presented which corrects for nonidealities in vapor-liquid equilibria. The second virial coefficient is used to represent gas nonideality, and a binary interaction parameter is used for liquid nonideality. The latter is the primary contribution for the deviation from Raoult's Law of H_2-D_2 solutions between 15 and 27K. Estimates are made for the parameters needed to describe the D_2-DT-T_2 solutions of hydrogen fusion interest.

9408 **Key issues for remote inspection and repair of a tokamak.** Hagmann, D.; White, J. (Remote Technology Corp., Oak Ridge, TN (USA)). pp 57-68 of Fusion technology 1982. Proceedings of the 12. symposium held in Juelich, 13-17 September 1982. Vol. 2. Oxford, England; Pergamon Press (1983). (CONF-820948—).

From 12. symposium on fusion technology; Juelich, F.R. Germany (13 Sep 1982).

Price Pound125.00.

The maintenance of radioactive components in nuclear fission and fusion plants is similar in many respects. Because of the similarities, a broad base of technology exists on nuclear fission,

which can be applied to fusion. Fusion machines, however, do have significantly more complex configurations and unique maintenance needs that can only be satisfied with new developments.

99 GENERAL AND MISCELLANEOUS

9409 **(CONF-8411124—1) Review of computer mapping and display techniques applicable to regional analysis.** Durfee, R.C. (Oak Ridge National Lab., TN (USA)). Nov 1984. Contract AC05-84OR21400. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003545.

From DOE transportation colloquium; Oak Ridge, TN, USA (27 Nov 1984).

Intent of this paper was to introduce some of the concepts and methods associated with processing geographic data for regional analyses. Focus has been upon describing the data structures for representing geographic features, techniques for digitizing data, various types of spatial transformations and analyses, geographic modeling, and graphic display in map form. Results from a variety of real-world applications have been shown to aid in describing the techniques. Selection of data structures and spatial transformations to solve a particular geographic application will determine to a large extent the cost of digitizing data, performing the analyses, and the types of graphic displays available. They will also effect the resolution of the data captured and the scales at which it can be used. The investigator must not only be familiar with the data elements used in his analysis, but he must be aware of what various thematic transformations on a spatial basis can do to his data. For example, the conversion of certain types of county-level data to watersheds based on proportionate area techniques can sometimes distort or smear-out the distributions so that erroneous conclusions are made on a hydrologic basis.

9410 **(DOE/ER/30059—1) Needs, opportunities, and options for large scale systems research.** Thompson, G.L. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Graduate School of Industrial Administration). Oct 1984. Contract AC01-84ER30059. 65p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85004642.

The Office of Energy Research was recently asked to perform a study of Large Scale Systems in order to facilitate the development of a true large systems theory. It was decided to ask experts in the fields of electrical engineering, chemical engineering and manufacturing/operations research for their ideas concerning large scale systems research. The author was asked to distribute a questionnaire among these experts to find out their opinions concerning recent accomplishments and future research directions in large scale systems research. He was also requested to convene a conference which included three experts in each area as panel members to discuss the general area of large scale systems research. The conference was held on March 26-27, 1984 in Pittsburgh with nine panel members, and 15 other attendees. The present report is a summary of the ideas presented and the recommendations proposed by the attendees.

9411 **(GAO/RCED—84-14) Alaska land conveyance program: a slow, complex, and costly process.** (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 12 Jun 1984. 76p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760. File Number TI85900504.

Report to The Secretary of the Interior.

Under the Alaska Statehood Act of 1958, and the Alaska Native Claims Settlement Act of 1971, the state is entitled to receive 104 million acres of land and Alaska native corporations are entitled to receive 44 million acres of land from the federal government. As of December 1983, the native corporations and the state have received legal title to surveyed land for 26 of the 148 million acres. Obstacles slowing the Department of the Interior's conveyance of land include having to resolve over 8800 pending individual Alaska native claims for small parcels of land and surveying the boundaries of over 72 million acres of land. The land surveys at current funding levels could take over 40 years and cost over $300 million to complete. GAD makes recommendations to the Secretary of the Interior on ways to improve the land conveyance program.

9901 Management

REFER ALSO TO CITATION(S) 9901008981

9412 **(DOE/IG—0215) Action required to adequately control overtime compensation at the Department of Energy.** (USDOE Office of Inspector General, Washington, DC). 26 Dec 1984. 11p. OSTI. File Number TI85004588.

Report to The Secretary.

During the past three years departmental employees paid by the Headquarters Payroll Office averaged over $80,000 in overtime pay each biweekly period. Much of this pay has gone to a relatively small number of employees. During the first 12 pay periods of 1984, 1% of the employees received about 32% of the total overtime compensation paid. Major problems were found regarding the administration of overtime. Recommendations are given for added internal controls.

9413 **(DOE/MA—0008/13) Department of Energy audit followup and internal control review tracking systems. Quarterly management report as of June 30, 1984.** (USDOE Assistant Secretary for Management and Administration, Washington, DC. Office of the Controller). Aug 1984. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE84016383.

During the quarter ended June 30, 1984, there were 229 audit reports received and 220 closed, with the number of open audit reports increasing to 398 by the end of the period. Thirty-one of those open reports were more than two years old, an increase of two from the prior ending balance. The amount potentially due DOE decreased to approximately $31.4 million, due to the fact that new questioned costs during the quarter were almost $1.5 million less than the combined amount for reinstated and recovered questioned costs. There were six unresolved audit reports over six months old at June 30, 1984, with $37,575 potentially due to the government. During the quarter nine final and six draft internal control review reports were issued. The nine final reports contained 23 significant recommendations which were added to the 29 recommendations previously entered in the DOE Internal Control Tracking System. Thirty-six recommendations were closed during the quarter. At June 30, 1984, 16 recommendations in nine internal control review reports remained open. Also, at June 30, 1984, 67 of the 145 inventoried internal control reviews were completed (23) or in progress (44). 7 tables.

9414 **(DOE/MA—0008/14) Department of Energy audit followup and internal control review tracking systems. Quarterly management report as of September 30, 1984.** (USDOE Assistant Secretary for Management and Administration, Washington, DC. Office of the Controller). Nov 1984. 32p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85003490.

This report provides information to Department of Energy (DOE) management on the status of audit followup and internal control review activities. It is based on data accumulated in accordance with DOE Order 2300.1A which established the DOE Audit Report Tracking System (DARTS), and the DOE Internal Control Tracking System (DICTS) which is described in draft DOE Order 1000.3A. These tracking systems are required by Office of Management and Budget Circulars A-50, Audit Followup, and A-123, Internal Control Systems. DOE Order 2300.1A further provides for bringing to the attention of the DOE Internal Control and Audit Review Council (DICARC) such matters as corrective actions inordinately delayed and unresolved disagreements between audit and action offices.

9415 **(LA-UR—84-3529) Los Alamos National Laboratory compliance with cultural resource management legislation.** Olinger, C.E.; Rea, K.H. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 6p. (CONF-841187—17). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003730.

From 5. DOE environmental protection information meeting; Albuquerque, NM, USA (6 Nov 1984).

Cultural resources management is one aspect of NEPA-induced legislation increasingly affecting federal land managers. A number of regulations, some of them recent, outline management criteria for protecting cultural resources on federal land. Nearly all construction projects at the 11,135 hectare Los Alamos National Laboratory in northern New Mexico are affected by cultural resource management requirements. A substantial prehistoric Puebloan population occupied the Laboratory area from the 13th to the early 16th centuries. Grazing, timbering, and homesteading followed Indian occupation. Therefore, archaeological and historical ruins and artifacts are abundant. The Laboratory has developed a cultural resources management program which meets both legal and project planning requirements. The program operates in coordination with the New Mexico State Historical Preservation Office. Major elements of the Laboratory program are illustrated by a current project involving relocation of a homesteader's cabin located on land required for a major new facility. The Laboratory cultural resource management program couples routine oversight of all engineering design projects with onsite resource surveys and necessary mitigation prior to construction. The Laboratory has successfully protected major archaeological and historical ruins, although some problems remain. The cultural resource program is intended to be adjustable to new needs. A cultural resource management plan will provide long-term management guidance.

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 9902008426, 8996, 9032

9416 **(AD-A—145408/1) Supercomputers and VLSI: the effect of large scale integration on computer architecture. Interim report.** Snyder, L. (Washington Univ., Seattle (USA). Dept. of Computer Science). Aug 1984. 12p. (TR—84-08-05). NTIS, PC A02/MF A01.

The use of VLSI technology to build supercomputers is analyzed in depth. The benefits of VLSI are reviewed, and the liabilities are explored thoroughly. The perimeter problem and the planarity problem are identified as being critical limits on architectural design. The CHiP architecture, a highly parallel computer designed with VLSI implementation in mind, is scrutinized in terms of how well it exploits the benefit fo VLSI and how well it avoids the liabilities. Not surprisingly, it does pretty well.

9417 **(AD-A—145424/8) Parallel searching and merging on ZMOB. Technical report.** Kasif, S. (Maryland Univ., College Park (USA). Center for Automation Research). Jun 1984. 41p. (CSC-TR—1405). NTIS, PC A03/MF A01.

One of the most difficult issues that must be addressed when studying a class of parallel algorithms is the problem of choosing a model that captures the inherent difficulty of implementing these algorithms on a multiprocessor architecture. Shared memory models have proven to be an effective tool for deriving lower bounds on the complexity of comparison problems. In particular, a speed-up of lg(P) is possible for the problem of finding an element in an N-element sorted list, and speed-ups of PlglgP and P are possible for merging N-element sorted lists of P processors for the cases N=P and P<N respectively. In practice, these speed-ups are not attainable since the shared memory models ignore many practical considerations in multiprocessor systems, such as interprocessor communications, distribution of data on local memories and limited fan-out of memory locations. In this paper we introduce a model for parallel computation that is strictly weaker than the shared memory models. The model is based on an actual machine currently being constructed (ZMOB). We examine the communication facilities available in the model and show that lower bounds for merging and searching on shared memory models are attainable (within a constant).

9418 **(AD-A—145725/8) Prism machine: an alternative to the pyramid. Technical report.** Rosenfeld, A. (Maryland Univ., College Park (USA). Center for Automation Research). Jul 1984. 18p. NTIS, PC A02/MF A01.

The prism machine is a stack of n cellular arrays, each of size (2 to the n power x 2 to the n power). Cell (i,j) on level k is connected to cells (i,j), (i+2 to the k power, j), and (i,j+2 to the K power) on level k+1, 1 < or = k < n, where the sums are modulo 2 to the n power. Such a machine can perform various operations (e.g., Gaussian convolutions or least-squares polynomial fits) on image neighborhoods of power-of-2 sizes in every position in O(n) time, unlike a pyramid machine which can do this only in sampled positions. It can also compute the discrete Fourier transform in O(n) time.

9419 **(ANL/MCS-TM—25) Implementation of some concurrent algorithms for matrix factorization.** Dongarra, J.J.; Sameh, A.H.; Sorensen, D.C. (Argonne National Lab., IL (USA)). Oct 1984. Contract W-31-109-ENG-38. 20p. NTIS, PC A02. File Number DE85004687.

Three parallel algorithms for computing the QR-factorization of a matrix are presented. The discussion is primarily concerned with implementation of these algorithms on a computer that supports tightly coupled parallel processes sharing a large common memory. The three algorithms are a Householder method based upon high-level modules, a Windowed Householder method that avoids fork-join synchronization, and a Pipelined Givens method that is a variant of the data-flow type algorithms offering large enough granularity to mask synchronization costs. Numerical experiments were conducted on the Denelcor HEP computer. The computational results indicate that the Pipelined Givens method is preferred and that this is primarily due to the number of array references required by the various algorithms. 5 references.

9420 **(ANL/MCS-TM—33) Parallel linear algebra library for the Denelcor HEP.** Dongarra, J.J.; Sorensen, D.C. (Argonne National Lab., IL (USA)). Oct 1984. Contract W-31-109-ENG-38. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004685.

This paper discusses the implementation of a library of algorithms for problems in linear algebra on the Denelcor HEP. The package includes some of the most heavily used subroutines from LINPACK, that is, solution of linear systems based on LU, Cholesky, and QR factorizations as well as the appropriate triangular solvers. The concept followed is to code these routines in terms of high-level modules, which provides a vehicle to achieve both transportability and efficiency across a wide range of architectures. We discuss this concept in the context of a numerical linear algebra software library which is adaptable to highly parallel computing systems. However, the concept is expected to applicable to other libraries as well.

9421 **(ANL/MCS-TM—36) Short note on achievable LIP rates using the Warren Abstract Prolog Machine.** Gabriel, J.; Lindholm, T.G.; Lusk, E.L.; Overbeek, R.A. (Argonne National Lab., IL (USA)). Oct 1984. Contract W-31-109-ENG-38. 16p. NTIS, PC A02. File Number DE85004686.

The Abstract Prolog Machine proposed by David Warren in 1983 has attracted a great deal of interest. The authors have implemented a loader and an interpreter for the Warren Machine in C, and an assembler in Prolog for the Warren Machine instruction set. The work was done on a VAX 11/780. This document summarizes attainable LIP rates for the VAX, demonstrates that a portable implementation of Prolog on a VAX is capable of reaching 80 to 110 instructions per logical inference, and offers some quantitative basis for evaluating the relative merits of interpreting abstract machine code in C versus compiling directly to C.

9422 **(ANL/MCS-TM—37) Software for special functions.** Cody, W.J. (Argonne National Lab., IL (USA)). Oct 1984. Contract W-31-109-ENG-38. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004684.

We have maintained a private index of Bessel function programs for many years, and have frequently used it to respond to users seeking information on such software. This paper expands the index to include software for all sorts of special functions. Thus, we provide a partial answer to the question of availability. An alternative is to discuss desirable properties of special function software, and ways to determine to what extent the properties exist in a given program. This, of course, leads to a discussion of testing methodology. Each of these topics is too complicated to be dis-

cussed fully here. We can only provide an overview of each, to present some of the major considerations and some of the accepted practices. We must rely on citations to more detailed discussions elsewhere to satisfy those who are deeply interested in a topic. Quality and transportability of software take an effort on the part of those writing it; we hope that they, in particular, will find the references useful. Accordingly, Section 2 discusses desirable characteristics of special function software, and the compromises necessary in its preparation. Section 3 discusses testing such software for accuracy and overall performance. Section 4 lists major sources or special function software and discusses the general characteristics of each collection. Finally, extensive tables in Section 5 and a large bibliography point to much of the software available for the more common special functions. 59 references.

9423 (BNL—35351) Sequential minimization for sum of squares of unknown functions. Kao, S.C.;. (Brookhaven National Lab., Upton, NY (USA)). 13 Aug 1984. Contract AC02-76CH00016. 13p. (CONF-840849—8). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004162.

From Annual meeting of the American Statistical Association (ASA); Philadelphia, PA, USA (12 Aug 1984).

In practical situations is a frequent need to find an optimal point in a given domain such that the optimal point minimizes an objective function which is in the form as a sum of squares of unknown functions. Assume that the objective function is denoted by F(chi), where chi = (chi$_1$, chi$_2$,..., chi/sub n/)/sup T/ with T being the symbol indicating the transpose of a vector or a matrix. Then F(x) is the sum of squares of functions f/sub i/(x), i=1,2,...,m. Each function f/sub i/(x) actually represents a special characteristic. The analytical expression of f/sub i/(x) is not known, and its value is normally numerically calculated. The goal is to find chi = chi$_0$ such that F(chi$_0$) attains the minimum of F(chi) for chi in a predetermined domain D. A sequential scheme is presented in this work with some numerical tests provided to illustrate the feasibility of the sequential scheme. To find each f/sub i/(x) value for given x is very costly in actual cases. Therefore our goodness criteria for a scheme is to have the number of the sequentially selected points as less as possible under the condition that the end point of the sequence is within certain accuracy limit to chi$_0$.

9424 (DOE/METC—85-8) VAX/ASPEN installation guide. Williams, K.E. (EG and G/Washington Analytical Services Center, Inc., Morgantown, WV (USA)). Nov 1984. Contract AC21-81MC14521. 290p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE85001973.

Information necessary to install the ASPEN computerized simulation program on the VAX system is provided.

9425 (DOE/METC—85-9) METC VAX/IBM guide to ASPEN. Williams, K.E.; Regenhardt, P.A. (EG and G/Washington Analytical Services Center, Inc., Morgantown, WV (USA)). Nov 1984. Contract AC21-81MC14521. 122p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85001974.

This guide serves as a handbook for operating the public version of ASPEN as installed and supported by METC on the VAX computer operating under the VMS operating system and on the IBM 3033 computer at Argonne National Laboratory operating under the MVS operating system with CMS/SP. This guide should be used along with Volumes I and II of MIT's ASPEN User's Manual. Volume I contains the ASPEN input language descriptions for writing an ASPEN input file and basic descriptions of the ASPEN systems. It also contains information concerning physical properties and databanks. Volume II contains descriptions of the system models in ASPEN and answers specific operational questions. Table 1 is an index to the various ASPEN manuals.

9426 (IKE—4-115) DFN-RYST: Distribution of a model and methods bank (with data base) in an open network. Ehnis, L.; Haussmann, C.; Lang, R.; Loebich, I.; Ruehle, R. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme). May 1984. 76p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE85750110.

This performance specification specifies the requirements to be met by DFN-RSYST. DFN-RSYST has several intermediate communication levels between the user level RSYST, or rather the RSYST modules, and the DFN communication services. For this purpose, a junction had to be established between the specification modules commonly used in RSYST and the specification modules listed in the publication 'Zur Spezifikation von Kommunikationssystemen im DFN'. The interfaces to each level are represented as abstract data types. The user interfaces, or rather the extensions of the existing RSYST user interfaces, are represented in Backus/Naur notation. The level functions (services) are described in pseudocode. A number of procedures have been introduced whose function can, in general, be derived from their names. These procedures and their parameters are specified in another section, with a verbal semantic description. Status and error parameters are available in all cases while closer state-of-error and status specifications have been omitted with few exceptions. They will, however, be introduced in the specification phase. DFN-RSYST is programmed in Standard FORTRAN 77 in the form of subroutines, independent of the operating system. It is automatically loaded into the application system from a subroutine library.

9427 (SLAC-PUB—3454) Universal file processing program for field programmable integrated circuits. Freytag, D.R.; Nelson, D.J. (Stanford Linear Accelerator Center, CA (USA)). Sep 1984. Contract AC03-76SF00515. 4p. (CONF-841007—33). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004384.

From Nuclear science symposium; Orlando, FL, USA (31 Oct 1984).

A computer program is presented that translates logic equations into promburner files (or the reverse) for programmable logic devices of various kinds, namely PROMs FPLAs, FPLSs and PALs. The program achieves flexibility through the use of a database containing detailed information about the devices to be programmed. New devices can thus be accommodated through simple extensions of the database. When writing logic equations, the user can define logic combinations of signals as new logic variables for use in subsequent equations. This procedure yields compact and transparent expressions for logic operations, thus reducing the chances for error. A logic simulation program is also provided so that an independent check of the design can be performed at the software level.

9428 (SOL—84-5) Direct secant updates of sparse matrix factors. Chadee, F. (Stanford Univ., CA (USA). Systems Optimization Lab.). Sep 1984. Contract AT03-76ER72018. 58p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85004008.

Quasi-Newton methods for the solution of large sparse systems of non-linear equations suffer two disadvantages versus quasi-Newton methods for small systems. They require a matrix factorization on each iterate and also need to maintain in storage both the Jacobian approximation and its factors at the same time. Two updating techniques, which are applied directly to the factors of the matrix approximation and which attempt to remove these two disadvantages, are discussed here. A theoretical analysis of local Q-superlinear convergence is presented.

9905 Civilian Defense

9429 (AD-A—145947/8/XAD) Determination and analysis of candidate industrial protection countermeasures and strategies. Volume 1. Main report. Final report. Fischer, M.J.; Leonard, F.W.; Wei, M.S. (Engineering and Economics Research, Inc., Vienna, VA (USA)). Jun 1984. 159p. (TR—013-84). NTIS, PC A08/MF A01.

This report presents analyses and final results of a study to assist the Federal Emergency Management Agency, (FEMA) in development of the Protection of Industrial Capability (PIC) program. The study supports planning activities associated with the industrial countermeasures component of the PIC program. The purpose of the study was to develop cost-effective and feasible industrial protection strategies which could be employed to assure critical levels of production from essential industries in the event of a strategic nuclear attack. The report: enumerates the types of damage mechanisms to which industry would be exposed and de-

scribes the nature of industrial vulnerability; characterizes various protective countermeasures and assesses their applicability to specific industries; and evaluates the cost effectiveness and feasibility of the various protection strategies.

CORPORATE AUTHOR INDEX

In the Corporate Author Index, report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

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DOE Energy Data Base: Corporate Author Entries (DOE/TIC-4585) is used in the standardization of corporate entries. DOE/TIC-4585 is available for purchase from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia 22161.

A

Aarhus Univ. (Denmark). Geografisk Inst.
Energy, regional development and urban structure, 10:8673 (R;DK;In Danish)

Acurex Corp., Mountain View, CA (USA). Energy and Environmental Div.
Fuel Staging NO/sub x/ Control Test Program. First quarterly report, September 15-December 15, 1982, 10:8253 (R;US)

Advanced Fuel Research, Inc., East Hartford, CT (USA)
Measurements and theory of coal pyrolysis, 10:8111 (R;US)

Aerospace Corp., El Segundo, CA (USA). Vehicle Engineering Div.
Particle size distribution on surfaces in clean rooms. Final technical report September 1983-February 1984, 10:9039 (R;US)

Aerospace Medical Research Lab. (6570th), Wright-Patterson AFB, OH (USA)
Brightness comparison of electroluminescent versus incandescent lighting: a photometric validation. Final report, 10:8726 (R;US)

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The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

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AC05-76OR00001	**Goodyear Atomic Corp., Piketon, OH (USA). Chemical and Materials Technology Dept.**	
	10:8417	GAT-T—3282
AC05-76OR00033	**USDOE Assistant Secretary for Nuclear Energy, Washington, DC. Office of Nuclear Safety**	
	10:8614	CONF-840257—Vol.2
	Oak Ridge Associated Universities, Inc., TN (USA)	
	10:8652	ORAU/IEA—84-3(M)
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AC05-77ET20163	**WLVEC Technology Co., Adel, IA (USA)**	
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AC05-78OR03054	**International Coal Refining Co., Allentown, PA (USA)**	
	10:8135	DOE/OR/03054—47
	10:8136	DOE/OR/03054—T35
AC05-80ET13702	**Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Materials Engineering**	
	10:8110	DOE/ET/13702—12
AC05-82OR20900	**Virginia Univ., Charlottesville (USA). School of Engineering and Applied Science**	
	10:8365	CONF-830642—
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AC05-84OR21400	**Oak Ridge National Lab., TN (USA)**	
	10:8209	ORNL/FETEP—11
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	10:8398	CONF-8409115—18
	10:8418	NUREG/CR—3738
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	Institute of Gas Technology, Chicago, IL (USA)	
	10:8455	DOE/OR/21400—T76
	Oak Ridge National Lab., TN (USA)	
	10:8580	CONF-841017—3
	10:8586	ORNL/CSD/TM—218
	10:8596	ORNL-tr—5170([1985]).
	10:8608	NUREG/CR—3886
	10:8648	NUREG/CR—3591-Vol.2
	10:8650	NUREG/CR—3885-Vol.1
	10:8654	ORNL/TM—9327
	10:8823	Physical Review [Section] B: Condensed Matter 30 NO. 10. 5508-5515 (15 Nov 1984).
	10:8846	Journal of the Less-Common Metals 26 335-353 (1972).
	10:8869	Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films 2 NO. 4. 1495-149
	Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center	
	10:8917	ORNL/Sub—81-95013/1
	Miami Univ., Coral Gables, FL (USA). Dept. of Mechanical Engineering	
	10:8930	ORNL/Sub—2975/1
	10:8931	ORNL/Sub—2975/2
	10:8932	ORNL/Sub—2975/3
	10:8933	ORNL/Sub—2975/4

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	Rockwell International Corp., Thousand Oaks, CA (USA). Science Center	
	10:8943	ORNL/Sub—83-51926/1
	Oak Ridge National Lab., TN (USA)	
	10:9013	CAPE—2942(18 Jan 1962).
	10:9090	ORNL/TM—9394
	10:9102	CONF-841251—1
	10:9307	CONF-8411121—1
	10:9308	CONF-8411121—2
	10:9352	CONF-8411121—3
	10:9404	Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films 2 NO. 4. 1583-158
	10:9409	CONF-8411124—1
AC05-84OR21486	**Air Products and Chemicals, Inc., Allentown, PA (USA)**	
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	10:8139	DOE/OR/21486—T4
	10:8140	DOE/OR/21486—T5
	10:8141	DOE/OR/21486—T6
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AC05-84OS21400	**Oak Ridge Y-12 Plant, TN (USA)**	
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AC05-84OT21400	**Oak Ridge Gaseous Diffusion Plant, TN (USA)**	
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AC06-76FP02170	**Hanford Engineering Development Lab., Richland, WA (USA)**	
	10:8589	HEDL-SA—3067-FP
	10:8590	HEDL-SA—3146-FP
AC06-76RL01830	**Battelle Pacific Northwest Labs., Richland, WA (USA)**	
	10:8395	EPRI-NP—3765
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	10:8594	PNL-SA—12053
	10:8599	NUREG/CR—3911-Vol.1
	10:8600	NUREG/CR—3918
	10:8759	PNL—5183
	10:8771	PNL—5314
	10:8843	Journal of Chemical Physics 81 NO. 11. 5211-5213 (1 Dec 1984).
	10:9053	PNL—3656
AC06-77RL01030	**Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations**	
	10:9119	RHO-BW-ST—49-P
AC07-76ID01570	**EG and G Idaho, Inc., Idaho Falls (USA)**	
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	10:8597	EGG-M—19784
	10:8601	EGG-M—07484
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	EG and G Idaho, Inc., Idaho Falls (USA)	
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	Idaho National Engineering Lab., Idaho Falls (USA)	
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AC07-84ID12435	**Westinghouse Idaho Nuclear Co., Inc., Idaho Falls (USA)**	
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AC08-80DP40124	**Laboratory for Laser Energetics, University of Rochester, 250 East River Road, Rochester, New York 1**	
	10:9325	Physics of Fluids 27 NO. 12. 2960-2965 (Dec 1984).
	10:9327	Physical Review Letters 53 NO. 20. 1912-1914 (12 Nov 1984).
AC08-82DP40152	**KMS Fusion, Inc., Ann Arbor, MI (USA)**	
	10:9398	KMSF-U—1488
AC08-84NV10327	**Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA)**	
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AC09-76SR00001	**Georgia Inst. of Tech., Atlanta (USA). School of Mechanical Engineering**	
	10:8609	DPST—84-876
	Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.	
	10:8799	DP-MS—84-74
	10:8891	Hwahak Konghak 15 NO. 5. 355-363 (1977).
AC11-76PN00292	**Duquesne Light Co., Pittsburgh, PA (USA)**	
	10:8581	DLCS—5000384
AC18-84FC10614	**Brigham Young Univ., Provo, UT (USA). Combustion Lab.**	
	10:8173	DOE/FC/10614—T14
AC18-84FC10617	**Brown Univ., Providence, RI (USA). Div. of Engineering**	
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AC21-81FE05122	**Advanced Fuel Research, Inc., East Hartford, CT (USA)**	
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AC21-81MC14521	**EG and G/Washington Analytical Services Center, Inc., Morgantown, WV (USA)**	
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AC22-80MC14617	**State Univ. of New York, Buffalo (USA). Dept. of Chemical Engineering**	
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AC22-81PC40267	**Combustion Engineering, Inc., Windsor, CT (USA)**	
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AC22-81PC40271	**KVB, Inc., Irvine, CA (USA). Research Applications Div.**	
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AC22-81PC40275	**Massachusetts Inst. of Tech., Cambridge (USA)**	
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AC22-81PC40286	**Battelle Columbus Labs., OH (USA)**	
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AC12-82FE60148	NOXSO Corp., Paducah, KY (USA)	
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AC22-82PC50268	Acurex Corp., Mountain View, CA (USA). Energy and Environmental Div.	
	10:8253	DOE/PC/50268—1
AI01-76ET10393	NCB (IEA Grimethorpe) Ltd., Grimethorpe, Barnsley, South Yorkshire (UK)	
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AI01-76ET20485	Cleveland State Univ., OH (USA). Dept. of Electrical Engineering	
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AI01-76EV03230	Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.	
	10:9096	DOE/EV/03230—T1
AI01-77CS51040	National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center	
	10:8788	DOE/NASA/51040—57
AI01-80ET17037	Dayton Univ., OH (USA). School of Engineering	
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AI03-82SF11592	Jet Propulsion Lab., Pasadena, CA (USA)	
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AM01-76PR93000	National Academy of Sciences, Washington, DC (USA). Commission on Natural Resources	
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AS04-83ER60119	New Mexico Univ., Albuquerque (USA)	
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AS04-84EI19646	Oklahoma Univ., Norman (USA). Energy Resources Inst.	
	10:8260	DOE/EI/19646—T6
AS05-76ER04447	Tennessee Univ., Knoxville (USA). Dept. of Chemistry	
	10:8893	DOE/ER/04447—186
AS05-76ER04699	Louisiana State Univ., Baton Rouge (USA). Dept. of Physics and Astronomy	
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AS05-76ER05246	Georgia Inst. of Tech., Atlanta (USA). Engineering Experiment Station	
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AS05-76ET12034	Houston Univ., TX (USA)	
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AS05-76EV03801	Miami Univ., FL (USA). Rosenstiel School of Marine and Atmospheric Sciences	
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AS05-79ER10419	Florida State Univ., Tallahassee (USA)	
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AS05-79ER10513	Oklahoma Univ., Norman (USA). Dept. of Physics and Astronomy	
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AS05-81ER40032	Rice Univ., Houston, TX (USA). Bonner Nuclear Labs.	
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AS05-81ER40039	Texas A and M Univ., College Station (USA). Dept. of Physics	
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AS09-76EV00639	Georgia Univ., Athens (USA). Inst. of Ecology	
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AS19-80BC10345	Texas Univ., Austin (USA)	
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AT03-76ER72018	Stanford Univ., CA (USA). Systems Optimization Lab.	
	10:9428	SOL—84-5
AT03-82ER40069	Department of Astronomy, University of California, Berkeley, California 94720	
	10:9135	Physical Review Letters 53 NO. 17. 1700-1703 (22 Oct 1984).
AT03-84ER53158	GA Technologies Inc., San Diego, California 92138	
	10:9323	Physics of Fluids 27 NO. 12. 2874-2876 (Dec 1984).
AT19-81BC10476	Oklahoma Univ., Norman (USA)	
	10:8896	DOE/BC/10476—11
AT21-81MC16552	West Virginia Univ., Morgantown (USA). Dept. of Civil Engineering	
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FC01-83FE60149	National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)	
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FG02-84ER45055	Cornell Univ., Ithaca, NY (USA)	
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FG02-84ER45059	Michigan Univ., Ann Arbor (USA). Dept. of Physics	
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FG02-84ER45073	Battelle Columbus Labs., OH (USA)	
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FG02-84ER45116	Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering	
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FG05-82ER75009	Florida Solar Energy Center, Cape Canaveral (USA)	
	10:8784	FSEC-CR—57-82(EA)
FG05-84ER13228	Texas A and M Univ., College Station (USA). Research Foundation	
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FG07-81ID12222	Iowa State Univ. of Science and Technology, Ames (USA). Engineering Research Inst.	
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FG22-83PC60783	**Air Products and Chemicals, Inc., Allentown, PA (USA)**	
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	10:9159	Journal of the Optical Society of America B: Optical Physics 1 NO. 4. 609-625 (Aug 1984).
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CONF-8405223-	(Cold Spring Harbor symposium on quantitative biology in collaboration with NIH, Cold Spring Harbor, NY, USA, 30 May-5 Jun 1984)			
1	*See* BNL-35002	DE84015288	MN -48	10:9086
CONF-8405240-	(Transport and propagation in nonlinear systems, Los Alamos, NM, USA, 21-25 May 1984)			
2	*See* LA-UR-84-3762	DE85003734	MN -11	10:9120
CONF-8406124-	(2. workshop on containment integrity, Crystal City, VA, USA, 13-15 Jun 1984)			
	See NUREG/CP-0056	TI85002504	MN -78	10:8646
CONF-8406198-	(Design and utilization of the superconducting super collider summer study, Snowmass, CO, USA, 23 Jun-13 Jul 1984)			
24	*See* LA-UR-84-3526	DE85003749	MN -28	10:8975
25	*See* BNL-35406	DE85004163	MN -28	10:8967
CONF-8406207-	(Workshop on coincident particle emission from continuum states (OPECOS '84), Bad Honnef, F.R. Germany, 4-7 Jun 1984)			
1	*See* GSI-84-39(Prepr.)	DE85750093	MN -34D	10:9255
CONF-8406221-	(7. international seminar on high energy physics problems, multiquark interactions and quantum chromodynamics, Dubna, USSR, 19-23 Jun 1984)			
1	*See* NBI-HE-84-23	DE85700250	MN -34D	10:9200
CONF-8406225-	(6. international conference on trends in the theory and practice of nonlinear analysis, Dallas, TX, USA, 18-22 Jun 1984)			
1	*See* LA-UR-84-3522	DE85003727	MN -32	10:9305
CONF-840789-	(International conference on particles and nuclei, Heidelberg, F.R. Germany, 30 Jul-3 Aug 1984)			
6	*See* TRI-PP-84-60	DE85900220	MN -34C	10:9206
7	*See* TRI-PP-84-74	DE85900289	MN -34D	10:9180
CONF-840813-	(Design, construction and operation of nuclear power plants conference, Portland, OR, USA, 5-8 Aug 1984)			
	Trans. Am. Nucl. Soc., 46: No. 1, 129-132(1984)			10:8655

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CONF-840849-	(Annual meeting of the American Statistical Association (ASA), Philadelphia, PA, USA, 12-16 Aug 1984)			
8	*See* BNL-35351	DE85004162	MN -32	10:9423
CONF-8408133-	(Japan/US seminar on fundamentals of structural ceramics, Seattle, WA, USA, 1 Aug 1984)			
1	*See* LA-UR-84-3524	DE85003712	MN -25	10:8839
CONF-8408135-	(International radiation symposium, Perugia, Italy, 21-29 Aug 1984)			
1	*See* PNL-SA-12207	DE85003633	MN -37	10:8476
CONF-840902-	(5. ASTM-Euratom symposium on reactor dosimetry, Geesthacht, F.R. Germany, 24-28 Sep 1984)			
18	*See* EGG-M-25583	DE85003406	MN -80	10:8604
CONF-840914-	(International meeting on thermal nuclear reactor safety, Karlsruhe, F.R. Germany, 10-14 Sep 1984)			
18	*See* EGG-M-03584	DE85003426	MN -78	10:8616
19	*See* EGG-M-05484	DE85003435	MN -78	10:8624
20	*See* EGG-M-04984	DE85003434	MN -78	10:8620
21	*See* EGG-M-03684	DE85003425	MN -78	10:8617
22	*See* EGG-M-05384	DE85003429	MN -78	10:8623
23	*See* EGG-M-16884	DE85003431	MN -78	10:8629
24	*See* EGG-M-04084	DE85003430	MN -78	10:8618
25	*See* EGG-M-05284	DE85003428	MN -78	10:8622
26	*See* EGG-M-05184	DE85003433	MN -78	10:8621
27	*See* EGG-M-04884	DE85003432	MN -78	10:8619
CONF-840916-	(Robotics and remote handling in the nuclear industry conference, Toronto, Ontario, Canada, 23-27 Sep 1984)			
5	*See* TRI-PP-84-94	DE85900434	MN -28	10:9010
CONF-840945-	(Topical conference on neutron-nucleus collisions--a probe of nuclear structure, Glouster, OH, USA, 5-8 Sep 1984)			
11	*See* LA-UR-84-3506	DE85003713	MN -34C	10:9002
CONF-8409104-	(59. annual Society of Petroleum Engineers of AIME technical conference, Houston, TX, USA, 16-19 Sep 1984)			
	Soc. Pet. Eng. AIME, Pap., SPE13134: 9(Sep 1984)			10:8325
CONF-8409109-	(Industrial temperature measurement symposium, Knoxville, TN, USA, 10-12 Sep 1984)			
6	*See* EGG-M-07484	DE85003436	MN -78	10:8601
CONF-8409115-	(6. annual Low-Level Waste Management Program participants' information meeting, Denver, CO, USA, 11-13 Sep 1984)			
18	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004432	MN -70B	10:8398
CONF-8409118-	(Passive and hybrid solar energy update, Washington, DC, USA, 5-7 Sep 1984)			
	NTIS, PC A13/MF A01; 1 (GPO Dep.)	DE85003442	STD -59b	10:8499
CONF-8409162-	(6. international symposium on high energy spin physics, Marseille, France, 12-19 Sep 1984)			
5	*See* SLAC-PUB-3472	DE85004390	MN -28	10:8978
6	*See* TRI-PP-84-95	DE85900436	MN -34	10:9011
7	*See* BNL-35448	DE85004158	MN -28	10:8968
CONF-8409188-	(EFC-ACHEMA meeting on environment sensitive cracking problems in nuclear installations containing high temperature water, Munich, F.R. Germany, 17-22 Sep 1984)			
1	*See* BNL-NUREG-35428	TI85003205	MN -78	10:8578
CONF-841007-	(Nuclear science symposium, Orlando, FL, USA, 31 Oct-2 Nov 1984)			
33	*See* SLAC-PUB-3454	DE85004384	MN -32	10:9427
34	*See* SLAC-PUB-3467	DE85004383	MN -28	10:9009
35	*See* SLAC-PUB-3508	DE85004650	MN -28	10:8966
CONF-841017-	(Specialists' meeting on reactor noise - SMORN IV, Dijon, France, 15-19 Oct 1984)			
3	NTIS, PC A02/MF A01 (GPO Dep.)	DE85002476	MN -78	10:8580
CONF-841075-	(International thermal hydraulics and plant operations topical meeting, Taipei, Taiwan, 22-24 Oct 1984)			
5	*See* EGG-M-12284	DE85003549	MN -78	10:8627
6	*See* EGG-M-16184	DE85003548	MN -78	10:8628
8	*See* EGG-M-08884	DE85003418	MN -78	10:8625
9	*See* EGG-M-10384	DE85003419	MN -78	10:8626
CONF-8410103-	(Automotive technology development contractors' coordination meeting, Dearborn, MI, USA, 29 Oct-2 Nov 1984)			
2	*See* DOE/NASA/51040-57	DE85004111	STD -25	10:8788
CONF-8410142-	(12. water reactor safety research information meeting, Gaithersburg, MD, USA, 23-26 Oct 1984)			
42	*See* EGG-M-23684	DE85003556	MN -78	10:8637

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45	*See* BNL-NUREG-35410	TI85003031	MN -78	10:8613
46	*See* EGG-M-18884	DE85003592	MN -78	10:8632
47	*See* EGG-M-19084	DE85003595	MN -78	10:8634
48	*See* EGG-M-19884	DE85003551	MN -78	10:8635
50	*See* EGG-M-20184	DE85003555	MN -78	10:8394
53	*See* EGG-M-19784	DE85003408	MN -78	10:8597
55	*See* EGG-M-18984	DE85003593	MN -78	10:8633
57	*See* EGG-M-23784	DE85003412	MN -78	10:8638
59	*See* EGG-M-24184	DE85003559	MN -78	10:8639
62	*See* EGG-M-18684	DE85003410	MN -80	10:8631
63	*See* EGG-M-18384	DE85003589	MN -78	10:8630
CONF-8410144-	(International symposium on nuclear shell model, Philadelphia, PA, USA, 31 Oct-3 Nov 1984)			
3	*See* UCRL-91788	DE85004205	MN -34B	10:9134
CONF-8410161-	(18. European symposium on calcified tissue, Angers, France, 11-18 Oct 1984)			
2	*See* EGG-M-20084	DE85003557	MN -80	10:8636
CONF-8410179-	(DOE geothermal technology conference, El Centro, CA, USA, 16-18 Oct 1984)			
2	*See* EGG-M-23484	DE85003558	MN -66d	10:8519
CONF-8410197-	(30. annual conference on bioassay, analytical and environmental chemistry, Cincinnati, OH, USA, 10 Oct 1984)			
1	*See* EGG-M-16384	DE85003553	MN -4	10:8872
CONF-841105-	(Joint meeting of the American Nuclear Society and the Atomic Industrial Forum, Washington, DC, USA, 11-16 Nov 1984)			
39	*See* HEDL-SA-3146-FP	DE85003009	MN -79b	10:8590
CONF-841115-	(International conference on power plant simulation, Mexico City, Mexico, 19-21 Nov 1984)			
5	*See* BNL-NUREG-35280	TI85001224	MN -80	10:8579
CONF-841117-	(8. conference on the application of accelerators in research and industry, Denton, TX, USA, 12-14 Nov 1984)			
26	*See* LA-UR-84-3518	DE85003726	MN -34D	10:9254
CONF-841157-	(Symposium on the scientific basis for nuclear waste management, Boston, MA, USA, 26-29 Nov 1984)			
24	*See* SAND-84-1293C	DE85003533	MN -25	10:8867
25	*See* UCRL-90853	DE85004412	MN -70	10:8413
26	*See* SAND-84-1145C	DE85004170	MN -25	10:8411
27	*See* DP-MS-84-74	DE85003617	MN -25	10:8799
CONF-841184-	(30. annual conference on magnetism and magnetic materials, San Diego, CA, USA, 27-30 Nov 1984)			
20	*See* LA-UR-84-3486	DE85003724	MN -25	10:8863
23	*See* BNL-35427	DE85004165	MN -38	10:8855
CONF-841187-	(5. DOE environmental protection information meeting, Albuquerque, NM, USA, 6-8 Nov 1984)			
7-Pt.2	*See* PNL-SA-12053	DE85003632	MN -80	10:8594
15	*See* GAT-T-3282	DE85003686	MN -22	10:8417
16	*See* LA-UR-84-3528	DE85003729	MN -41	10:8423
17	*See* LA-UR-84-3529	DE85003730	MN -13	10:9415
CONF-8411111-	(Japan/US joint symposium on compact toroid research, Hiroshima, Japan, 13-15 Nov 1984)			
4	*See* LA-UR-84-3575	DE85003732	MN -20f	10:9399
CONF-8411118-	(Meeting on nuclear standard reference data, Geel, Belgium, 12-16 Nov 1984)			
2	*See* LA-UR-84-3556	DE85003731	MN -34C	10:9256
3	*See* EGG-M-24484	DE85003255	MN -34C	10:9260
CONF-8411119-	(IEEE ultrasonics symposium, Dallas, TX, USA, 14-16 Nov 1984)			
2	*See* EGG-M-14484	DE85003259	MN -25	10:8935
CONF-8411120-	(7. International Society for Optical Engineering meeting on thermosense, Cambridge, MA, USA, 5-8 Nov 1984)			
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4	*See* EGG-M-24784	DE85004322	MN -38	10:8907
CONF-8411121-	(US/USSR atomic energy agreement for scientific and technical cooperation for peaceful usage meeting, Moscow, USSR, 12-20 Nov 1984)			
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2	NTIS, PC A04; 3	TI85003341	MN -20	10:9308
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CONF-8411124-	(DOE transportation colloquium, Oak Ridge, TN, USA, 27-28 Nov 1984)			
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CONF-841201-	(ASME winter annual meeting, New Orleans, LA, USA, 9-13 Dec 1984)			
22	*See* LA-UR-84-3651	DE85003773	MN -38	10:8928
CONF-841203-	(6. international conference on fracture, New Delhi, India, 4-10 Dec 1984)			
4	*See* LA-UR-84-3496	DE85003779	MN -25	10:8838

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4	*See* UCRL-90686	DE85004421	MN -34C	10:9261
CONF-841218-	(31. national vacuum symposium, Reno, NV, USA, 3-7 Dec 1984)			
12	*See* LA-UR-84-3634	DE85003774	MN -25	10:9024
13	*See* FNAL-TM-1291	DE85004114	STD -28	10:9001
14	*See* UCRL-90949-Rev.1	DE85004423	MN -20d	10:9320
CONF-841249-	(Fall DECUS symposium, Anaheim, CA, USA, 10-14 Dec 1984)			
1	*See* KMSF-U-1488	DE85003692	MN -21	10:9398
CONF-841250-	(International conference on engineering ceramics, Jerusalem, Israel, 16-21 Dec 1984)			
1	*See* UCRL-90611	DE85004414	MN -4	10:8842
CONF-841251-	(EPA quality based toxics reduction program meeting, Cincinnati, OH, USA, 3-4 Dec 1984)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004431	MN -48	10:9102
CONF-850118-	(3. international modal analysis conference, Orlando, FL, USA, 28-31 Jan 1985)			
1	*See* K/D-5599	DE84017413	MN -38	10:8914
2	*See* LA-UR-84-2911	DE85002027	MN -34	10:8915
CONF-850136-	(23. AIAA aerospace sciences meeting, Reno, NV, USA, 14-17 Jan 1985)			
1	*See* UCRL-90920	DE85003453	MN -41	10:9038
CONF-850311-	(National Association of Corrosion Engineers annual meeting and materials performance and corrosion show, Boston, MA, USA, 25-29 Mar 1985)			
3	*See* UCRL-91804	DE85004415	MN -70	10:8822
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1621-Vol.2	NTIS, PC A08/MF A01; 1 (GPO Dep.)	DE85001979	STD -90e	10:8246
1622	NTIS, PC A04/MF A01 (GPO Dep.)	DE84011988	STD -90e	10:8247
1657	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84012000	STD -90e	10:8248
1658	NTIS, PC A13/MF A01; 1 (GPO Dep.)	DE84011999	STD -90e	10:8249
DOE/ET/10518-				
T5	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004630	MN -90d	10:8109
DOE/ET/10630-				
T1	NTIS, PC A02/MF A01 (GPO Dep.)	DE85005220	MN -4	10:8897
T2	NTIS, PC A02/MF A01 (GPO Dep.)	DE85005219	MN -4	10:8898
DOE/ET/10679-				
T27	NTIS, PC A02/MF A0; 1 (GPO Dep.)	DE85003186	MN -38	10:8539

Report Number	Availability Source	File Number	Distribution Category	Abstract Number
DOE/ET/11423-				
T13	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003867	MN -90a	10:8165
T14	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003862	MN -90a	10:8166
T15	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003861	MN -90a	10:8167
T16	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003860	MN -90a	10:8168
T17	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85003864	MN -90a	10:8169
T18	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003865	MN -90a	10:8170
T19	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003863	MN -90a	10:8171
T20	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003866	MN -90a	10:8172
DOE/ET/12002-				
96	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004354	MN -92a	10:8271
DOE/ET/12034-				
T1	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004232	MN -92a	10:8272
DOE/ET/13702-				
12	NTIS, PC A11/MF A01; 1 (GPO Dep.)	DE85001307	STD -90c	10:8110
DOE/ET/15492-				
T50	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011849	MN -90i	10:8186
DOE/ET/17037-				
T1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85003448	MN -95	10:8780
DOE/ET/20163-				
T1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85000631	MN -96	10:8470
DOE/ET/20645-				
T1	NTIS, PC A12/MF A01; 1 (GPO Dep.)	DE85000735	STD -59a	10:8500
DOE/ET/28504-				
T1-Vol.1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85004061	MN -66	10:8517
DOE/ET/34212-				
44	NTIS (US Sales Only), PC A04/MF A01; 1 (GPO Dep.)	DE85005147	STD -78	10:8582
DOE/EV/00639-				
26	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE85003977	MN -48	10:9067
DOE/EV/02217-				
54	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85004376	MN -48	10:9089
DOE/EV/03230-				
T1	NTIS, PC A03/MF A01 (GPO Dep.)	DE85004094	MN -48	10:9096
DOE/EV/03801-				
T3	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004331	MN -11	10:9068
T4	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85004332	MN -11	10:9069
T7	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85004335	MN -11	10:9070
T8	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004336	STD -11	10:9071
T9	NTIS, PC A03/MF A01 (GPO Dep.)	DE85004337	MN -11	10:9072
T10	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85004338	MN -11	10:9073
T11	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85004339	MN -11	10:9074
DOE/EV/10095-				
T1	NTIS, PC A11/MF A01; 1 (GPO Dep.)	DE85003311	MN -41	10:9097
DOE/EV/10599-				
T1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85004564	MN -79p	10:8615
DOE/FC/10614-				
T14	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003978	STD -90b	10:8173
DOE/FC/10617-				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004119	STD -90a	10:8174
DOE/FE/05122-				
1668	NTIS, PC A08/MF A01; 1 (GPO Dep.)	DE85001962	STD -90c	10:8111
DOE/FE/60148-				
T5	NTIS, PC A10/MF A01; 1 (GPO Dep.)	DE85002617	STD -90a	10:8187
DOE/FE/60177-				
1680	NTIS, PC A04/MF A01 (GPO Dep.)	DE85000818	STD -91	10:8357
DOE/ID/12222-				
T2	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE85004130	STD -95f	10:8731
DOE/ID/12254-				
1	NTIS, PC A99/MF A01; 1 (GPO Dep.)	DE85004133	STD -97c	10:8464
DOE/IG-				
0214	OSTI	TI85003276	STD -13	10:8691
0215	OSTI	TI85004588	STD -13	10:9412
DOE/JPL-				
1060-77	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85004582	STD -62	10:8509
1060-78	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85004584	STD -62	10:8510
DOE/LC/10127-				
1640	NTIS, PC A21/MF A01; 1 (GPO Dep.)	DE84012010	STD -91	10:8360
DOE/MA-				
0008/ 13	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84016383	MN -5	10:9413
0008/ 14	NTIS, PC A03/MF A01 (GPO Dep.)	DE85003490	MN -13	10:9414
DOE/MC/11047-				
T2	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE84015216	MN -92a	10:8334
DOE/MC/14617-				
T1	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004212	MN -90d	10:8188
DOE/MC/16552-				
T1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85001287	MN -90i	10:9078
DOE/MC/19077-				
T4	NTIS, PC A02/MF A01 (GPO Dep.)	DE85005067	MN -93	10:8721
DOE/MC/19122-				
1684	NTIS, PC A04/MF A01 (GPO Dep.)	DE85004045	STD -90c	10:8113
DOE/MC/19163-				
1687	NTIS, PC A12/MF A01 (GPO Dep.)	DE85003203	STD -90c	10:8114
1688	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE85002887	STD -90c	10:8115

Report Number	*Availability Source*	*File Number*	*Distribution Category*	*Abstract Number*
DOE/MC/19265-				
1671	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE85001971	STD -90c	10:8116
1672	NTIS, PC A08/MF A01; 1 (GPO Dep.)	DE85001970	STD -90c	10:8117
1673	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE85001969	STD -90c	10:8118
1674	NTIS, PC A06/MF A01 (GPO Dep.)	DE85001966	STD -90c	10:8119
1675	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85001967	STD -90c	10:8120
1676	NTIS, PC A08/MF A01; 1 (GPO Dep.)	DE85001968	STD -90c	10:8121
1677	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE85001972	STD -90c	10:8122
1678	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE85001964	STD -90c	10:8123
1679	NTIS, PC A10/MF A01; 1 (GPO Dep.)	DE85001965	STD -90c	10:8124
DOE/MC/20468-				
1645	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84016324	STD -90i	10:8125
DOE/METC-				
84-9	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84009291	MN -92	10:8311
84-30	NTIS, PC A02/MF A01 (GPO Dep.)	DE84012016	STD -90a	10:8871
85-8	NTIS, PC A13/MF A01; 1 (GPO Dep.)	DE85001973	STD -90	10:9424
85-9	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE85001974	STD -90	10:9425
DOE/METC/SP-				
203	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84003076	STD -93	10:8722
DOE/NASA-				
0017-1	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE85003070	STD -93	10:8723
0290-01	NTIS, PC A15/MF A01; 1 (GPO Dep.)	DE85003811	STD -97d	10:8540
DOE/NASA/20485-				
17	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85000535	STD -63d	10:8492
DOE/NASA/51040-				
57	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004111	STD -25	10:8788
DOE/NBM-				
1077	NTIS, PC A09/MF A01; 1 (GPO Dep.)	DE85000865	STD -60	10:8527
DOE/NE-				
0025/ 3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004047	STD -70	10:8399
DOE/NV/10327-				
2	NTIS, PC A03/MF A01 (GPO Dep.)	DE85003968	MN -38	10:8950
3	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85003930	MN -38	10:8951
DOE/OR/03054-				
47	NTIS, PC A19/MF A01; 1 (GPO Dep.)	DE85004494	STD -89	10:8135
T35	NTIS, PC A03; 3	DE85001617	MN -89	10:8136
T36	*See* DOE/OR/21486-T2	DE85004620	STD -89	10:8137
T37	*See* DOE/OR/21486-T3	DE85003807	STD -89	10:8138
T38	*See* DOE/OR/21486-T4	DE85004616	STD -89	10:8139
T39	*See* DOE/OR/21486-T5	DE85004621	STD -89	10:8140
T40	*See* DOE/OR/21486-T6	DE85004615	STD -89	10:8141
T41	*See* DOE/OR/21486-T7	DE85004619	STD -89	10:8142
T42	*See* DOE/OR/21486-T8	DE85004614	STD -89	10:8143
T43	*See* DOE/OR/21486-T9	DE85004625	STD -89	10:8144
T44	*See* DOE/OR/21486-T10	DE85004624	STD -89	10:8145
T45	*See* DOE/OR/21486-T11	DE85004626	STD -89	10:8146
T47	*See* DOE/OR/21486-T13	DE85004622	STD -89	10:8147
DOE/OR/21400-				
2	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85000417	STD -11	10:9047
T76	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85003707	MN -92b	10:8455
DOE/OR/21486-				
T2	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE85004620	STD -89	10:8137
T3	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85003807	STD -89	10:8138
T4	NTIS, PC A19/MF A01; 1 (GPO Dep.)	DE85004616	STD -89	10:8139
T5	NTIS, PC A20/MF A01; 1 (GPO Dep.)	DE85004621	STD -89	10:8140
T6	NTIS, PC A22/MF A01; 1 (GPO Dep.)	DE85004615	STD -89	10:8141
T7	NTIS, PC A25/MF A01; 1 (GPO Dep.)	DE85004619	STD -89	10:8142
T8	NTIS, PC A20/MF A01; 1 (GPO Dep.)	DE85004614	STD -89	10:8143
T9	NTIS, PC A20/MF A01; 1 (GPO Dep.)	DE85004625	STD -89	10:8144
T10	NTIS, PC A22/MF A01; 1 (GPO Dep.)	DE85004624	STD -89	10:8145
T11	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE85004626	STD -89	10:8146
T13	NTIS, PC A25/MF A01; 1 (GPO Dep.)	DE85004622	STD -89	10:8147
DOE/PC/40267-				
1	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004226	MN -90a	10:8175
DOE/PC/40268-				
T6	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85005226	MN -90a	10:8176
DOE/PC/40271-				
T1	NTIS, PC A04; 3	DE85004370	MN -90a	10:8250
DOE/PC/40275-				
T1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85004106	MN -90d	10:8251
DOE/PC/40286-				
10	NTIS, PC A03/MF A01 (GPO Dep.)	DE85003874	MN -90a	10:8252
DOE/PC/40782-				
T8	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004211	MN -90d	10:8148
DOE/PC/50268-				
1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85004216	MN -90i	10:8253
DOE/PC/50809-				
T7	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004215	MN -90a	10:8177
DOE/PC/60783-				
5	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004374	STD -90d	10:8149
DOE/PE/70151-				
T6	NTIS, PC A03; 3	DE85004062	MN -90	10:8150
DOE/PETC/TR-				
85/ 3	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85004009	STD -90i	10:8178

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85/ 4	NTIS, PC A05/MF A01 (GPO Dep.)	DE85004576	STD -90d	10:8151
DOE/PR/93000- T1	NTIS, PC A13/MF A01; 1 (GPO Dep.)	DE85003336	MN -70	10:8400
DOE/R8/01064- T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85003582	MN -61E	10:8456
DOE/RA/50153- T1	NTIS, PC A08/MF A01; 1 (GPO Dep.)	DE85002975	STD -97a	10:8566
DOE/RG- 0062(83)	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85000264	MN -98E	10:8684
DOE/S- 0010(84)	NTIS, PC A11/MF A01; 1 (GPO Dep.)	DE85000347	MN -5	10:8685
DOE/SF/11447- T1	NTIS, PC A03/MF A01 (GPO Dep.)	DE85004228	MN -59a	10:8501
DOE/SF/11540- T2	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85004481	MN -66	10:8518
DOE/SF/11592- 1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85004580	STD -62b	10:8511
2	NTIS, PC A08/MF A01; 1 (GPO Dep.)	DE85004581	STD -62b	10:8512
DOE/SF/11595- T1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85002891	MN -59a	10:8502
DP-MS- 84-74	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003617	MN -25	10:8799
DP-tr- 71	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85001368	MN -4	10:8891
DPST- 84-876	NTIS, PC A10/MF A01; 1 (GPO Dep.)	DE85003260	MN -80	10:8609
DS- 135.12	*See* PB-85-101392/XAD			10:8715
DTH-ABK-R- 167	NTIS (US Sales Only), PC A05/MF A01; 1	TI85750407	MN -60	10:8528
DTH-LET-RE- 84-8	NTIS (US Sales Only), PC A06/MF A01; 1	TI85750427	MN -90b	10:8235
DTH-LV-MEDD- 125	NTIS (US Sales Only), PC A06/MF A01; 1	TI85750412	MN -59a	10:8503
136	NTIS (US Sales Only), PC A05/MF A01; 1	TI85750413	MN -62	10:8513
EFN-LET- 1983-09	NTIS (US Sales Only), PC A02/MF A01; 1	TI85750445	MN -64	10:8522
1983-10	NTIS (US Sales Only), PC A03/MF A01; 1	TI85750446	MN -64	10:8521
1983-12	NTIS (US Sales Only), PC A09/MF A01	TI85750447	MN -64	10:8525
1983-21	NTIS (US Sales Only), PC A04/MF A01; 1	TI85750448	MN -64	10:8523
1983-22	NTIS (US Sales Only), PC A07; 3	TI85750449	MN -64	10:9060
1983-25	NTIS (US Sales Only), PC A14/MF A01; 1	TI85750450	MN -94	10:8663
EGG-ED- 6725	NTIS, PC A03/MF A01 (GPO Dep.)	DE85005159	MN -96	10:8789
EGG-M- 03584	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003426	MN -78	10:8616
03684	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003425	MN -78	10:8617
04084	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003430	MN -78	10:8618
04884	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003432	MN -78	10:8619
04984	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003434	MN -78	10:8620
05184	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003433	MN -78	10:8621
05284	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003428	MN -78	10:8622
05384	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003429	MN -78	10:8623
05484	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003435	MN -78	10:8624
07484	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003436	MN -78	10:8601
08884	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003418	MN -78	10:8625
10384	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003419	MN -78	10:8626
12284	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003549	MN -78	10:8627
14484	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003259	MN -25	10:8935
16184	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003548	MN -78	10:8628
16384	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003553	MN -4	10:8872
16884	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003431	MN -78	10:8629
18384	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003589	MN -78	10:8630
18684	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003410	MN -80	10:8631
18884	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003592	MN -78	10:8632
18984	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003593	MN -78	10:8633
19084	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003595	MN -78	10:8634
19784	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003408	MN -78	10:8597
19884	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003551	MN -78	10:8635
20084	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003557	MN -80	10:8636
20184	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003555	MN -78	10:8394
23484	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003558	MN -66d	10:8519
23684	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003556	MN -78	10:8637
23784	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003412	MN -78	10:8638
24184	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003559	MN -78	10:8639
24484	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003255	MN -34C	10:9260
24784	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004322	MN -38	10:8907
25583	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003406	MN -80	10:8604
EIR- 528	NTIS (US Sales Only), PC A04/MF A01	DE85750701	MN -96	10:8732
EML- 433	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE85004136	STD -11	10:9057
ENDF- 202	*See* BNL-19302-Vol.2	DE85003919	MN -34C	10:9274

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EPA-				
600/ D-84/ 248	*See* PB-85-106698/XAD			10:9040
EPA/520/5-				
84/ 019	*See* PB-85-101756/XAD			10:9083
EPA/600-				
D-84/ 203	*See* PB-84-246230			10:9103
D-84/ 233	*See* PB-85-102879/XAD			10:9052
EPRI-CS-				
3675	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920087	ND -90	10:8800
EPRI-EA-				
3736	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $10.00	TI85920149	ND -97	10:8710
EPRI-EL-				
3669	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303	TI85920128	ND -97	10:8561
3729-Vol.1	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $19.00	TI85920147	ND -97	10:8562
EPRI-NP-				
3680	Research Reports Center, Box 50490, Palo Alto, CA 94303, $14.50	TI85920004	ND -70	10:8401
3752-SR	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $11.50	TI85920140	ND -78	10:8640
3765	NTIS, PC A05/MF A01 - EPRI (GPO Dep.)	DE85003685	MN -85	10:8395
3780	NTIS, PC A04/MF A01; 1 - EPRI (GPO Dep.)	DE85003281	MN -78	10:8583
ETU-				
2026-02	*See* STEV-BF-84-3	TI85750451	MN -95	10:8783
EUR-				
8739-EN	*See* PB-85-100782/XAD			10:8306
8812-DE	*See* PB-85-101111/XAD			10:8408
8907-EN	*See* PB-85-100808/XAD			10:8449
FE-				
2013-13	*See* DOE/ET/10518-T5	DE85004630	MN -90d	10:8109
2468-96	*See* DOE/ET/10679-T27	DE85003186	MN -38	10:8539
FNAL/Pub-				
84/ 110-A	NTIS, PC A02; 3	DE85003921	MN -34D	10:9189
84/ 120-A	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003953	MN -34B	10:9127
84/ 126-A	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003952	MN -34B	10:9128
FNAL-TM-				
1100	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003348	MN -28	10:8980
1103	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85003349	MN -28	10:8969
1105	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003347	MN -28	10:8981
1106	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85003350	MN -28	10:8970
1108	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85003766	MN -48	10:9277
1112	NTIS, PC A03; 3 (GPO Dep.)	DE85003768	MN -28	10:8955
1114	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003772	MN -38	10:8941
1116	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003771	MN -38	10:8912
1117	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003770	MN -28	10:8982
1118	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003344	MN -28	10:8971
1119	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003345	MN -28	10:8983
1120	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003346	MN -28	10:8956
1121	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004261	MN -28	10:8984
1122	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004262	MN -28	10:8985
1134	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004277	MN -28	10:8957
1137	NTIS, PC A02/MF 01; 1 (GPO Dep.)	DE85004278	MN -28	10:8972
1149	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004260	MN -38	10:8942
1150	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004274	MN -28	10:8986
1152	NTIS, PC A03/MF A01 (GPO Dep.)	DE85004276	MN -48	10:9278
1153	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004268	MN -28	10:8973
1157	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004270	MN -28	10:9019
1158	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004271	MN -28	10:9020
1159	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004272	MN -28	10:8958
1162	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85004273	MN -28	10:8987
1163	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85004264	MN -41	10:8331
1164	NTIS, PC A02; 3	DE85004265	MN -28	10:8988
1165	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004266	MN -28	10:8989
1168	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004267	MN -28	10:8990
1170	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004246	MN -28	10:8959
1172	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004247	MN -38	10:8936
1177	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85004248	MN -28	10:8991
1179	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004249	MN -28	10:8992
1180	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004263	MN -28	10:8993
1183	NTIS, PC A02; 3	TI85004254	MN -28	10:8960
1195	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004255	MN -28	10:8994
1197	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004256	MN -28	10:8801
1201	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85004257	MN -28	10:9021
1207	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004258	MN -28	10:8995
1220	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85004245	MN -28	10:8974
1221-A	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004250	MN -48	10:9279
1226	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004251	MN -28	10:8961
1230	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE85004252	MN -2	10:8996
1249	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004191	MN -28	10:8997
1251	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85004192	MN -28	10:8998
1284	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85004115	STD -37	10:9022

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1288	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004113	STD -28	10:8999
1289	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85004121	STD -28	10:9000
1291	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004114	STD -28	10:9001
FOA-C-				
40196-B4	*See* PB-85-104289/XAD			10:8309
FRNC-TH-				
1420	NTIS (US Sales Only), PC A09/MF A01	DE84752342	MN -34D	10:9190
1557	NTIS (US Sales Only), PC A07/MF A01	DE84752345	MN -25	10:8802
FSEC-CR-				
57-82(EA)	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85000612	MN -58c	10:8784
FWC/FWDC/TR-				
83/ 10	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85004230	MN -90a	10:8254
FWS/OBS-				
82/ 61	*See* PB-84-245612			10:8296
84/ 10	NTIS, PC A07/MF A01	TI85900739	MN -11	10:9064
GAO/RCED-				
84-14	General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760	TI85900504	MN -13	10:9411
84-61	US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760	TI85900505	MN -92	10:8307
84-85	General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760	TI85900501	MN -90c	10:8152
84-98	General Accounting Office P.O. Box 6015, Gaithersburg, MD 20760	TI85900502	MN -13	10:8689
84-101	US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760	TI85900450	MN -11	10:8677
84-163	US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760	TI85900448	MN -11	10:8676
84-200	US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760	TI85900443	MN -95	10:8682
84-201	US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760	TI85900442	MN -11	10:9061
85-40	General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760	TI85900503	MN -92	10:8308
GAT-T-				
3282	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003686	MN -22	10:8417
GEND-				
043	NTIS PC E03/MF A01 (GPO Dep.)	DE85003777	STD -78	10:8641
GEND-INF-				
058	NTIS, PC A03/MF A01 (GPO Dep.)	DE85003944	MN -78	10:8584
GKSS-				
84/ E/ 18	NTIS (US Sales Only), PC A03/MF A01	DE85750108	MN -80	10:8585
84/ E/ 20	NTIS (US Sales Only), PC A02/MF A01	TI85750470	MN -4	10:8873
GRS-A-				
894	*See* BMI-1984-046	TI85750109	MN -80	10:8602
GSF-R-				
369	NTIS (US Sales Only), PC A05/MF A01	DE85750072	MN -11	10:9075
GSI-				
84-1	NTIS (US Sales Only), PC A20/MF A01	TI85750474	MN -34C	10:9250
84-38(Prepr.)	NTIS (US Sales Only), PC A04/MF A01	DE85750091	MN -34C	10:9263
84-39(Prepr.)	NTIS (US Sales Only), PC A03/MF A01	DE85750093	MN -34D	10:9255
84-40(Prepr.)	NTIS (US Sales Only), PC A02/MF A01	DE85750094	MN -34D	10:9259
84-41(Prepr.)	NTIS (US Sales Only), PC A02/MF A01	DE85750092	MN -34D	10:9264
HEDL-SA-				
3067-FP	NTIS, PC A03/MF A01 (GPO Dep.)	DE85000863	MN -79k	10:8589
3146-FP	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003009	MN -79b	10:8590
HHE-				
71-037	*See* PB-84-241488			10:8258
72-004	*See* PB-84-239573			10:9112
HSE-Trans-				
7298	NTIS (US Sales Only), PC A02; 3	TI84901845	MN -92a	10:8265
10005	NTIS (US Sales Only), PC A02; 3	DE85900533	MN -88	10:8234
IAEA-TECDOC-				
307	NTIS (US Sales Only), PC A13/MF A01	DE85780122	MN -23	10:9098
IC-				
83/ 47	NTIS (US Sales Only), PC A02/MF A01	DE85700201	MN -34D	10:9214
83/ 77	NTIS (US Sales Only), PC A02/MF A01	DE85700213	MN -34A	10:9145
83/ 91	NTIS (US Sales Only), PC A02/MF A01	DE85700194	MN -34D	10:9160
83/ 98	NTIS (US Sales Only), PC A02/MF A01	DE85700221	MN -34A	10:9282
83/ 104	NTIS (US Sales Only), PC A02/MF A01	DE85700242	MN -34A	10:8858
83/ 110	NTIS (US Sales Only), PC A03/MF A01	DE85700243	MN -34A	10:8803
83/ 112	NTIS (US Sales Only), PC A02/MF A01	DE85700214	MN -34A	10:9283
83/ 115	NTIS (US Sales Only), PC A02/MF A01	DE85700244	MN -34A	10:9291
83/ 148	NTIS (US Sales Only), PC A02/MF A01	DE85700206	MN -34A	10:9146
83/ 162	NTIS (US Sales Only), PC A02/MF A01	DE85700245	MN -34A	10:9292
83/ 163	NTIS (US Sales Only), PC A02/MF A01	DE85700204	MN -34D	10:9209
83/ 168	NTIS (US Sales Only), PC A02/MF A01	DE85700215	MN -34A	10:9284
83/ 169	NTIS (US Sales Only), PC A02/MF A01	DE85700207	MN -34A	10:9285
83/ 170	NTIS (US Sales Only), PC A02/MF A01	DE85700188	MN -34D	10:9265
83/ 171	NTIS (US Sales Only), PC A02/MF A01	DE85700219	MN -34A	10:9286
83/ 172	NTIS (US Sales Only), PC A02/MF A01	DE85700189	MN -34D	10:9147
83/ 173	NTIS (US Sales Only), PC A02/MF A01	DE85700246	MN -34A	10:9161
83/ 176	NTIS (US Sales Only), PC A02/MF A01	DE85700208	MN -34A	10:9148
83/ 192	NTIS (US Sales Only), PC A02/MF A01	DE85700190	MN -34D	10:9287

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83/ 215	NTIS (US Sales Only), PC A02/MF A01	DE85700209	MN -34A	10:9149
83/ 218	NTIS (US Sales Only), PC A03/MF A01	DE85700195	MN -34D	10:9215
83/ 219	NTIS (US Sales Only), PC A02/MF A01	DE85700247	MN -34D	10:9191
83/ 220	NTIS (US Sales Only), PC A02/MF A01	DE85700196	MN -34D	10:9216
83/ 221	NTIS (US Sales Only), PC A24/MF A01	DE85780364	MN -34D	10:9165
83/ 224	NTIS (US Sales Only), PC A02/MF A01	DE85700248	MN -34D	10:9195
83/ 225	NTIS (US Sales Only), PC A02/MF A01	DE85700199	MN -34D	10:9225
83/ 226	NTIS (US Sales Only), PC A03/MF A01	DE85700200	MN -34D	10:9226
83/ 227	NTIS (US Sales Only), PC A02/MF A01	DE85700197	MN -34D	10:9131
83/ 229	NTIS (US Sales Only), PC A02/MF A01	DE85700186	MN -34D	10:9302
83/ 231	NTIS (US Sales Only), PC A02/MF A01	DE85700187	MN -34D	10:9303
83/ 232	NTIS (US Sales Only), PC A02/MF A01	DE85700191	MN -34D	10:9288
83/ 233	NTIS (US Sales Only), PC A02/MF A01	DE85700192	MN -34D	10:9294
83/ 234	NTIS (US Sales Only), PC A02/MF A01	DE85700210	MN -34A	10:9150
83/ 235	NTIS (US Sales Only), PC A02/MF A01	DE85700211	MN -34A	10:9151
83/ 236	NTIS (US Sales Only), PC A02/MF A01	DE85700193	MN -34D	10:9304
83/ 237	NTIS (US Sales Only), PC A04/MF A01	DE85700216	MN -34A	10:8859
83/ 238	NTIS (US Sales Only), PC A02/MF A01	DE85700241	MN -34B	10:9132
84/ 24	NTIS (US Sales Only), PC A02/MF A01	DE85700217	MN -34A	10:8860
84/ 25	NTIS (US Sales Only), PC A02/MF A01	DE85700218	MN -34A	10:8861
ICTIS/M-				
0169	Coal Research Association of New Zealand, Wellington			10:8236
0170	Coal Research Association of New Zealand, Wellington			10:8237
ICTIS/TR-				
27	International Energy Agency Coal Research, London, England			10:8238
IFIN-FT-				
211-1982	NTIS (US Sales Only), PC A02/MF A01	DE85700257	MN -34D	10:9196
IKE-				
2-66	NTIS (US Sales Only), PC A04/MF A01	DE85750107	MN -38	10:8926
4-115	NTIS (US Sales Only), PC A05/MF A01	DE85750110	MN -32	10:9426
IMMR-				
44-RRR7-79	*See* PB-85-106136/XAD			10:8239
47-RRR8-80	*See* PB-85-107951/XAD			10:8219
48-PD23-80	*See* PB-85-106128/XAD			10:8158
INIS-BR-				
138	NTIS (US Sales Only), PC A07/MF A01	TI85780087	MN -4	10:8874
147	NTIS (US Sales Only), PC A02/MF A01		MN -25	10:8804
148	NTIS (US Sales Only), PC A02/MF A01	TI85780088	MN -4	10:8875
INIS-mf-				
9058	NTIS (US Sales Only), PC A07/MF A01	TI84703479	MN -2	10:9251
9078	NTIS (US Sales Only), PC A18/MF A01	TI85780085	MN -34D	10:9299
9466	NTIS (US Sales Only), PC A03/MF A01	DE85780367	MN -34C	10:9252
INP-				
1180/ PH	NTIS (US Sales Only), PC A03/MF A01	TI84703477	MN -32	10:9276
IPP-				
1/ 225	NTIS (US Sales Only), PC A05/MF A01	DE85750105	MN -20	10:9309
1/ 227	NTIS (US Sales Only), PC A03/MF A01	DE85750099	MN -20	10:9384
4/ 211	NTIS (US Sales Only), PC A03/MF A01	TI85750469	MN -20a	10:9310
6/ 233	NTIS (US Sales Only), PC A04/MF A01	DE85750100	MN -20	10:9311
IS-J-				
1513	*See* BNL-35427	DE85004165	MN -38	10:8855
IS-M-				
518	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003078	MN -90i	10:8189
IS-T-				
1096	NTIS, PC A09/MF A01 (GPO Dep.)	DE85005120	MN -90a	10:8179
1160	NTIS, PC A04/MF A01 (GPO Dep.)	DE85004175	MN -4	10:8877
JAERI-M-				
83-120	NTIS (US Sales Only), PC A23/MF A01	DE85700228	MN -20	10:9385
83-125	NTIS (US Sales Only), PC A08/MF A01	DE85700238	MN -20	10:9386
83-130	NTIS (US Sales Only), PC A02/MF A01	DE85700224	MN -20	10:9312
83-139	NTIS (US Sales Only), PC A03/MF A01	DE85700229	MN -20	10:9387
83-146	NTIS (US Sales Only), PC A03/MF A01	DE85700225	MN -20	10:9313
83-154	NTIS (US Sales Only), PC A02/MF A01	DE85700237	MN -20	10:9388
83-159	NTIS (US Sales Only), PC A06/MF A01	DE85700235	MN -20	10:9314
83-162	NTIS (US Sales Only), PC A03/MF A01	DE85700226	MN -20	10:9315
83-165	NTIS (US Sales Only), PC A02/MF A01	DE85700236	MN -20	10:9316
83-171	NTIS (US Sales Only), PC A03/MF A01	DE85700222	MN -20	10:9317
83-177	NTIS (US Sales Only), PC A05/MF A01	DE85700231	MN -20	10:9389
83-190	NTIS (US Sales Only), PC A03/MF A01	DE85700223	MN -20	10:9318
83-194	NTIS (US Sales Only), PC A11/MF A01	DE85700230	MN -20	10:9390
83-195	NTIS (US Sales Only), PC A05/MF A01	DE85700232	MN -20	10:9391
83-196	NTIS (US Sales Only), PC A02/MF A01	DE85700233	MN -20	10:9392
83-204	NTIS (US Sales Only), PC A03/MF A01	DE85700240	MN -20	10:9393
83-219	NTIS (US Sales Only), PC A03/MF A01	DE85700234	MN -20	10:9394
83-220	NTIS (US Sales Only), PC A03/MF A01	DE85700239	MN -20	10:9395
83-240	NTIS (US Sales Only), PC A03/MF A01	DE85700212	MN -34A	10:9157
JINR-				
10-83-598	NTIS (US Sales Only), PC A02/MF A01	TI84703478	MN -32	10:9023
JPL-PUB-				
84-68	*See* DOE/SF/11592-1	DE85004580	STD -62b	10:8511
84-74	*See* DOE/SF/11592-2	DE85004581	STD -62b	10:8512

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84-75	*See* DOE/JPL-1060-77	DE85004582	STD -62	10:8509
84-76	*See* DOE/JPL-1060-78	DE85004584	STD -62	10:8510
Juel-				
1863	NTIS (US Sales Only), PC A08/MF A01	DE85750070	MN -25	10:8180
1871	NTIS (US Sales Only), PC A04/MF A01	DE85750071	MN -80	10:8386
1876	NTIS (US Sales Only), PC A07/MF A01	DE85750078	MN -20	10:9396
1894	NTIS (US Sales Only), PC A09/MF A01	DE85750077	MN -25	10:8862
1904	NTIS (US Sales Only), PC A06/MF A01	DE85750079	MN -25	10:8812
1906	NTIS (US Sales Only), PC A06/MF A01	DE85750103	MN -77	10:8587
1908	NTIS (US Sales Only), PC A06/MF A01	DE85750101	MN -80	10:8642
1912	NTIS (US Sales Only), PC A06/MF A01	DE85750102	MN -77	10:8588
1914	NTIS (US Sales Only), PC A03/MF A01	DE85750075	MN -25	10:8813
1915	NTIS (US Sales Only), PC A04/MF A01	DE85750098	MN -38	10:8913
1917	NTIS (US Sales Only), PC A06/MF A01	DE85750076	MN -80	10:8387
Juel-Spez-				
226	NTIS (US Sales Only), PC A06/MF A01	DE85750080	MN -25	10:8402
262	NTIS (US Sales Only), PC A06/MF A01; 1	TI85780227	MN -13	10:8672
K/D-				
5599	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84017413	MN -38	10:8914
K/OA-				
2101	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004049	MN -22	10:8385
KC-				
83/ 01d	NTIS (US Sales Only), PC A03/MF A01; 1	DE85750398	MN -38	10:8946
KEK-				
81-21	NTIS (US Sales Only), PC A03/MF A01	DE85780123	MN -28	10:8962
KFK-				
3298	NTIS (US Sales Only), PC A02/MF A01	DE85750090	MN -86	10:8388
3418	NTIS (US Sales Only), PC A04/MF A01	TI85750475	MN -11	10:9058
3490	NTIS (US Sales Only), PC A03/MF A01	DE85750097	MN -70	10:8403
3509	NTIS (US Sales Only), PC A04/MF A01	TI85750473	MN -79p	10:8643
3622	NTIS (US Sales Only), PC A02/MF A01	DE85750074	MN -25	10:8814
3644-B	NTIS (US Sales Only), PC A06/MF A01	DE85750106	MN -80	10:8605
3646	NTIS (US Sales Only), PC A03/MF A01	TI85750479	MN -34C	10:9273
3691	NTIS (US Sales Only), PC A03/MF A01	DE85750096	MN -4	10:8902
3692	NTIS (US Sales Only), PC A03/MF A01	DE85750095	MN -70	10:8404
3696	NTIS (US Sales Only), PC A03/MF A01	TI85750483	MN -20	10:9397
3700	NTIS (US Sales Only), PC A02/MF A01	TI85750484	MN -16	10:8424
3744	NTIS (US Sales Only), PC A04/MF A01	TI85750472	MN -38	10:8927
3753	NTIS (US Sales Only), PC A05/MF A01	TI85750477	MN -79p	10:8644
3773	NTIS (US Sales Only), PC A04/MF A01	TI85750471	MN -25	10:8837
3790	NTIS (US Sales Only), PC A03/MF A01	TI85750476	MN -16	10:8405
KMSF-U-				
1488	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003692	MN -21	10:9398
LA-				
10127-C	*See* NUREG/CP-0053	TI84016166	MN -80	10:8645
10170-PR	NTIS, PC A05/MF A01 (GPO Dep.)	DE85004488	STD -15	10:8425
10212-MS	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85005229	STD -13	10:8712
10230-MS	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85005233	STD -46	10:8606
10277-MS	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85005196	STD -28	10:8963
LA-UR-				
84-2911	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85002027	MN -34	10:8915
84-3486	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003724	MN -25	10:8863
84-3496	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003779	MN -25	10:8838
84-3506	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003713	MN -34C	10:9002
84-3518	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003726	MN -34D	10:9254
84-3522	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003727	MN -32	10:9305
84-3524	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003712	MN -25	10:8839
84-3526	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003749	MN -28	10:8975
84-3528	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003729	MN -41	10:8423
84-3529	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003730	MN -13	10:9415
84-3556	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003731	MN -34C	10:9256
84-3575	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003732	MN -20f	10:9399
84-3612	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003775	MN -25	10:8815
84-3634	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003774	MN -25	10:9024
84-3651	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003773	MN -38	10:8928
84-3762	NTIS, PC A02/MF A01 (GPO Dep.)	DE85003734	MN -11	10:9120
LBL-				
16999	NTIS, PC A14/MF A01; 1 (GPO Dep.)	DE85004652	MN -25	10:8816
17687	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85004653	MN -94cb	10:8664
18324	NTIS, PC A07/MF A01 (GPO Dep.)	DE85004108	MN -34	10:9293
18414	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85004345	STD -94c	10:8665
18500	NTIS, PC A04/MF A01 (GPO Dep.)	DE85003166	STD -28	10:9003
18542	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE85004439	STD -94c	10:8724
18574	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85003082	STD -94c	10:8666
18683	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004446	STD -95c	10:8733
18703	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004641	MN -34C	10:9133
18744	NTIS, PC A03/MF A01 (GPO Dep.)	DE85005110	MN -34B	10:9140
LITH-IFM-R-				
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1002-1-48	NTIS (US Sales Only), PC A05/MF A01; 1	TI85750442	MN -38	10:8929
MINTEK-SP-				
4	NTIS (US Sales Only), PC A14/MF A01	TI85780086	MN -4	10:8878

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3215(OP)	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003308	MN -38	10:8905
3216(OP)	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003307	MN -38	10:8906
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133	NTIS (US Sales Only), PC A05/MF A01	TI85750482	MN -28	10:9025
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12424	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85004474	MN -80	10:8591
NASA-CR-				
3795	NTIS, PC A04/MF A01	TI85005006	MN -48	10:9093
174638	*See* DOE/NASA-0017-1	DE85003070	STD -93	10:8723
174732	*See* DOE/NASA-0290-01	DE85003811	STD -97d	10:8540
NASA-TM-				
83790	*See* DOE/NASA/20485-17	DE85000535	STD -63d	10:8492
86888	*See* DOE/NASA/51040-57	DE85004111	STD -25	10:8788
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84-07	NTIS (US Sales Only), PC A04/MF A01	DE85700258	MN -34D	10:9198
84-13	NTIS (US Sales Only), PC A06/MF A01	DE85700261	MN -34D	10:9177
84-16	NTIS (US Sales Only), PC A02/MF A01	DE85700249	MN -34D	10:9199
84-23	NTIS (US Sales Only), PC A02/MF A01	DE85700250	MN -34D	10:9200
84-24	NTIS (US Sales Only), PC A02/MF A01	DE85700251	MN -34D	10:9231
84-25	NTIS (US Sales Only), PC A03/MF A01	DE85700259	MN -34D	10:9211
84-27	NTIS (US Sales Only), PC A02/MF A01	DE85700202	MN -34D	10:9232
84-28	NTIS (US Sales Only), PC A04/MF A01	DE85700203	MN -34D	10:9233
84-33	NTIS (US Sales Only), PC A02/MF A01	DE85700260	MN -34D	10:9234
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84/ 2910	*See* PB-85-104123/XAD			10:8277
84/ 3007	*See* PB-84-235878			10:8819
NEACRP-L-				
268	*See* JAERI-M-83-196	DE85700233	MN -20	10:9392
NFL-				
38	NTIS (US Sales Only), PC A06/MF A01	DE85700220	MN -34A	10:8607
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281122	NTIS (US Sales Only), PC A04/MF A01; 1	TI85750436	MN -92	10:8295
282054	NTIS (US Sales Only), MF A01; 2	TI85750437	MN -92a	10:8953
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84-6	NTIS (US Sales Only), PC A03/MF A01	DE85700198	MN -34D	10:9235
84-7	NTIS (US Sales Only), PC A02/MF A01	DE85700253	MN -34D	10:9212
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19-Vol.3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004365	MN -92	10:8790
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5750388	NTIS (US Sales Only), PC A04/MF A01; 1	TI85750388	MN -90i	10:8190
5750389	NTIS (US Sales Only), PC A03/MF A01	TI85750389	MN -95f	10:8765
5750390	NTIS (US Sales Only), PC A12/MF A01; 1	TI85750390	MN -95	10:8781
5750391	NTIS (US Sales Only), PC A10/MF A01; 1	TI85750391	MN -90i	10:8191
5750392	NTIS (US Sales Only), PC A06/MF A01; 1	TI85750392	MN -95d	10:8734
5750393	NTIS (US Sales Only), PC A05/MF A01; 1	TI85750393	MN -95f	10:8735
5750394	NTIS (US Sales Only), PC A03/MF A01; 1	TI85750394	MN 97e	10:8465
5750395	NTIS (US Sales Only), PC A03/MF A01; 1	TI85750395	MN -97e	10:8466
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5750400	NTIS (US Sales Only), PC A02; 3	TI85750400	MN -95d	10:8737
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5750402	NTIS (US Sales Only), PC A03/MF A01; 1	TI85750402	MN -95	10:8757
5750405	NTIS (US Sales Only), PC A06/MF A01; 1	TI85750405	MN -95	10:8673
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5750408	NTIS (US Sales Only), PC A11/MF A01; 1	TI85750408	MN -92a	10:8276
5750409	NTIS (US Sales Only), PC A03/MF A01	TI85750409	MN -95d	10:8738
5750414	NTIS (US Sales Only), PC A05/MF A01; 1	TI85750414	MN -61E	10:8478
5750415	Danmarks Tekniske Hoejskole, Laboratory for Koeleteknik, Lyngby	TI85750415	MN -95d	10:8766
5750416	NTIS (US Sales Only), PC A03/MF A01; 1	TI85750416	MN -95e	10:8767
5750417	NTIS (US Sales Only), PC A04/MF A01	TI85750417	MN -95d	10:8739
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5750419	NTIS (US Sales Only), PC A02/MF A01	TI85750419	MN -95	10:8741
5750420	NTIS (US Sales Only), PC A03/MF A01; 1	TI85750420	MN -4	10:8879
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5750429	NTIS (US Sales Only), PC A05/MF A01; 1	TI85750429	MN -90c	10:8153
5750433	NTIS (US Sales Only), PC A09/MF A01; 1	TI85750433	MN -92a	10:8680
5750439	NTIS (US Sales Only), PC A03/MF A01; 1	TI85750439	MN -95d	10:8742
5750440	NTIS (US Sales Only), PC A10/MF A01; 1	TI85750440	MN -92	10:8261
5770004	NTIS (US Sales Only), PC A09/MF A01; 1	TI85770004	MN -61E	10:8714
5770005	NTIS (US Sales Only), PC A11/MF A01; 1	TI85770005	MN -96A	10:8758
5770027	NTIS (US Sales Only), PC A03/MF A01	TI85770027	MN -92a	10:8262
5770028	NTIS (US Sales Only), PC A06/MF A01; 1	TI85770028	MN -11	10:8769
5770029	NTIS (US Sales Only), PC A08/MF A01; 1	TI85770029	MN -95d	10:8743
5770030	NTIS (US Sales Only), PC A08/MF A01; 1	TI85770030	MN -98A	10:8686
5770032	NTIS (US Sales Only), PC A03/MF A01	TI85770032	MN -90a	10:8154
5770033	NTIS (US Sales Only), PC A02/MF A01; 1	TI85770033	MN -98	10:8668
5770035	NTIS (US Sales Only), PC A02/MF A01; 1	TI85770035	MN -13	10:8669
5770036	NTIS (US Sales Only), PC A07/MF A01; 1	TI85770036	MN -4	10:8899

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5770042	NTIS (US Sales Only), PC A06/MF A01; 1	TI85770042	MN -60	10:9301
5770043	NTIS (US Sales Only), PC A05/MF A01; 1	TI85770043	MN -97	10:8567
5770044	NTIS (US Sales Only), PC A06/MF A01; 1	TI85770044	MN -92a	10:8305
5770047	NTIS (US Sales Only), PC A07/MF A01	TI85770047	MN -25	10:8817
5770048	NTIS (US Sales Only), PC A08/MF A01; 1	TI85770048	MN -90a	10:8155
5770049	NTIS (US Sales Only), PC A09/MF A01; 1	TI85770049	MN -92	10:8280
5770050	NTIS (US Sales Only), PC A06/MF A01; 1	TI85770050	MN -90d	10:8156
5770051	NTIS (US Sales Only), PC A08/MF A01; 1	TI85770051	MN -90c	10:8157
5770052	NTIS (US Sales Only), PC A09/MF A01; 1	TI85770052	MN -11	10:9049
5770053	NTIS (US Sales Only), PC A11/MF A01; 1	TI85770053	MN -48	10:9109
5770054	NTIS (US Sales Only), PC A03/MF A01	TI85770054	MN -98C	10:8687
5770059	NTIS (US Sales Only), PC A02/MF A01; 1	TI85770059	MN -13	10:8671
5770060	NTIS (US Sales Only), PC A06/MF A01; 1	TI85770060	MN -38	10:8916
5770061	NTIS (US Sales Only), PC A05/MF A01; 1	TI85770061	MN -96	10:8786
5770062	NTIS (US Sales Only), PC A08/MF A01; 1	TI85770062	MN -63	10:8479
5770064	NTIS (US Sales Only), PC A09/MF A01; 1	TI85770064	MN -59a	10:8504
5770065	NTIS (US Sales Only), PC A08/MF A01; 1	TI85770065	MN -96	10:8440
5770066	NTIS (US Sales Only), PC A07/MF A01	TI85770066	MN -96	10:8787
5770067	NTIS (US Sales Only), PC A08/MF A01	TI85770067	MN -96	10:8744
5770068	NTIS (US Sales Only), PC A08/MF A01	TI85770068	MN -61D	10:8480
5770069	NTIS (US Sales Only), PC A21/MF A01; 1	TI85770069	MN -25	10:8818
5770150	NTIS (US Sales Only), PC A08/MF A01; 1	DE85770150	MN -94cc	10:8901
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5483	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85004440	STD -20g	10:9319
NUREG-				
0390-Vol.7-No.2	NTIS, PC A10/MF A01 - GPO*	TI85900438	MN -80	10:8592
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0056	NTIS, PC A99/MF A01 - GPO	TI85002504	MN -78	10:8646
NUREG/CR-				
0200-Vols.1,2,3	NTIS PC E20/MF $7.50 - GPO	TI85004154	MN -15	10:8426
3440	NTIS, PC A13/MF A01 - GPO	TI85005161	MN -80	10:8647
3591-Vol.2	NTIS, PC A12/MF A01 - GPO (GPO Dep.)	TI84013526	MN -78	10:8648
3738	NTIS, PC A07/MF A01 - GPO	TI84016808	MN -78	10:8418
3784	NTIS, PC A11/MF A01 - GPO	TI85004287	MN -78	10:8649
3885-Vol.1	NTIS, PC A02/MF A01 - GPO	TI84017057	MN -77	10:8650
3886	NTIS, PC A03/MF A01 - GPO	TI85001905	MN -80	10:8608
3890	NTIS, PC A05/MF A01 - GPO $4.50	TI85003889	MN -70	10:8406
3911-Vol.1	NTIS, PC A03/MF A01 - GPO $3.75	TI85003998	MN -78	10:8599
3918	NTIS, PC A04/MF A01 - GPO $4.50	TI85005002	MN -78	10:8600
3976	NTIS, PC A06/MF A01 - GPO	TI85003897	MN -78	10:8651
4028	NTIS, PC A03/MF A01 - GPO	TI85000406	MN -78	10:8593
NWC-TP-				
6525	*See* AD-A-146467/6/XAD			10:9043
6535	*See* AD-A-145662/3			10:8516
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84/ 0031	*See* PB-84-246453			10:8264
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117	NTIS, PC A13/MF A01; 1 (GPO Dep.)	DE85004161	MN -70	10:8407
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84-3(M)	NTIS, PC A10/MF A01 (GPO Dep.)	DE85004240	MN -78	10:8652
84-7(M)	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85005143	MN -76	10:8653
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218	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85003793	MN -80	10:8586
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11	NTIS, PC A08/MF A01 (GPO Dep.)	DE85004775	MN -11	10:8209
12	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85004774	MN -11	10:8210
ORNL/NSIC-				
217/ V2	*See* NUREG/CR-3591-Vol.2	TI84013526	MN -78	10:8648
ORNL/NUREG/CSD-				
2/ R3	*See* NUREG/CR-0200-Vols.1,2,3	TI85004154	MN -15	10:8426
ORNL/Sub-				
81-95013/ 1	NTIS, PC A08/MF A01; 1 (GPO Dep.)	DE85003585	STD -97b	10:8917
83-51926/ 1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85004430	MN -25	10:8943
2975/ 1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85004419	MN -38	10:8930
2975/ 2	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85004426	MN -38	10:8931
2975/ 3	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85004417	MN -38	10:8932
2975/ 4	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85004429	MN -38	10:8933
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9118	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85003514	STD -86	10:8389
9120	NTIS, PC A07/MF A01 (GPO Dep.)	DE85004767	MN -11	10:8211
9150	*See* NUREG/CR-3738	TI84016808	MN -78	10:8418
9265	*See* NUREG/CR-3886	TI85001905	MN -80	10:8608
9267/ V1	*See* NUREG/CR-3885-Vol.1	TI84017057	MN -77	10:8650
9327	NTIS, PC A08/MF A01; 1 (GPO Dep.)	DE85004778	MN -41	10:8654
9394	NTIS, PC A02/MF A01 (GPO Dep.)	DE85004766	MN -48	10:9090
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5155	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85000731	MN -25	10:8846
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85-106128/ XAD	NTIS, PC A02/MF A01			10:8158
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5015-3	NTIS, PC A03/MF A01 (GPO Dep.)	DE84017024	MN -70	10:8420
5164	*See* NUREG/CR-3890	TI85003889	MN -70	10:8406
5177	NTIS, PC A04/MF A01 (GPO Dep.)	DE85003090	MN -70	10:8421
5181-Vol.1	*See* NUREG/CR-3911-Vol.1	TI85003998	MN -78	10:8599
5183	NTIS, PC A11/MF A01; 1 (GPO Dep.)	DE85002503	MN -96A	10:8759
5186	*See* NUREG/CR-3918	TI85005002	MN -78	10:8600
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12053	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85003632	MN -80	10:8594
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UG Uganda
US United States of America (USA)
UY Uruguay

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VD Democratic Republic of Vietnam
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VS Republic of Vietnam

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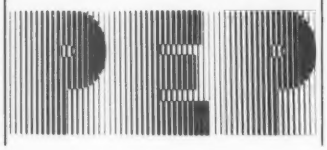

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